
# NAVAL POSTGRADUATE SCHOOL

**MONTEREY, CALIFORNIA**

# THESIS

**THE EFFECT OF ACTIVE DUTY PRESENCE ON HIGH QUALITY ENLISTED ACCESSIONS IN THE MARINE CORPS**

by

Johnathan R. Fergerson

December 2016

Thesis Advisor: Latika Hartmann
Co-Advisor: Marigee Bacolod

THIS PAGE INTENTIONALLY LEFT BLANK

| REPORT DOCUMENTATION PAGE | | | *Form Approved OMB No. 0704–0188* |
|---|---|---|---|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503. | | | |
| **1. AGENCY USE ONLY** ***(Leave blank)*** | **2. REPORT DATE** December 2016 | **3. REPORT TYPE AND DATES COVERED** Master's thesis | |
| **4. TITLE AND SUBTITLE** THE EFFECT OF ACTIVE DUTY PRESENCE ON HIGH QUALITY ENLISTED ACCESSIONS IN THE MARINE CORPS | | | **5. FUNDING NUMBERS** |
| **6. AUTHOR(S)** Johnathan R. Fergerson | | | |
| **7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)** Naval Postgraduate School Monterey, CA 93943-5000 | | | **8. PERFORMING ORGANIZATION REPORT NUMBER** |
| **9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)** N/A | | | **10. SPONSORING / MONITORING AGENCY REPORT NUMBER** |
| **11. SUPPLEMENTARY NOTES** The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB number NPS.2016.0065-IR-EP5-A . | | | |
| **12a. DISTRIBUTION / AVAILABILITY STATEMENT** Approved for public release. Distribution is unlimited. | | | **12b. DISTRIBUTION CODE** |

**13. ABSTRACT (maximum 200 words)**

This study examines the relationship between active duty Marine Corps locations and the accession of high quality enlisted personnel from 2000–2014. The population includes all individuals who accessed into the Marine Corps between 2000 and 2014. Information on their home of record at time of enlistment is merged with Marine Corps location data using geographic information system (GIS) models. The GIS models construct measures of distance between individual enlistees and active duty Marine Corps locations. Using the distance measures from the GIS models as key independent variables, we estimate the correlation between proximity to Marine Corps locations and test scores of enlisted personnel using multivariate linear regression and logit models. The results suggest that women, African Americans and high school graduates receive lower scores on the Armed Forces Qualification Test compared to men, whites and college graduates. Furthermore, the quality of personnel typically declines as distance increases, except for enlisted accessions located beyond the 100-mile radius, suggesting that the majority of high quality accessions come from rural regions. We also find that there is a greater probability of accessing exceptionally high quality enlistees if an individual's home of record is located beyond a 100-mile radius from an active duty location.

| **14. SUBJECT TERMS** Marine Corps enlisted accessions, enlisted accessions, high quality accessions, Marine Corps recruiting, recruiting, geographic information system, geospatial analysis | | | **15. NUMBER OF PAGES** 103 |
|---|---|---|---|
| | | | **16. PRICE CODE** |
| **17. SECURITY CLASSIFICATION OF REPORT** Unclassified | **18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified | **19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified | **20. LIMITATION OF ABSTRACT** UU |

NSN 7540–01-280-5500 Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

THIS PAGE INTENTIONALLY LEFT BLANK

**Approved for public release. Distribution is unlimited.**

# THE EFFECT OF ACTIVE DUTY PRESENCE ON HIGH QUALITY ENLISTED ACCESSIONS IN THE MARINE CORPS

Johnathan R. Fergerson
Captain, United States Marine Corps
B.S., University of Maine, 2011

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF SCIENCE IN MANAGEMENT**

from the

**NAVAL POSTGRADUATE SCHOOL**
**December 2016**

Approved by: Latika Hartmann
Thesis Advisor

Marigee Bacolod
Co-Advisor

Chad Seagren
Academic Associate
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

# ABSTRACT

This study examines the relationship between active duty Marine Corps locations and the accession of high quality enlisted personnel from 2000–2014. The population includes all individuals who accessed into the Marine Corps between 2000 and 2014. Information on their home of record at time of enlistment is merged with Marine Corps location data using geographic information system (GIS) models. The GIS models construct measures of distance between individual enlistees and active duty Marine Corps locations. Using the distance measures from the GIS models as key independent variables, we estimate the correlation between proximity to Marine Corps locations and test scores of enlisted personnel using multivariate linear regression and logit models. The results suggest that women, African Americans and high school graduates receive lower scores on the Armed Forces Qualification Test compared to men, whites and college graduates. Furthermore, the quality of personnel typically declines as distance increases, except for enlisted accessions located beyond the 100-mile radius, suggesting that the majority of high quality accessions come from rural regions. We also find that there is a greater probability of accessing exceptionally high quality enlistees if an individual's home of record is located beyond a 100-mile radius from an active duty location.

THIS PAGE INTENTIONALLY LEFT BLANK

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFEES | Armed Forces Entry Examination Station |
| AFQT | Armed Forces Qualification Test |
| AOR | Area of Responsibility |
| ASR | Authorized Strength Report |
| AVF | All-Volunteer Force |
| BIC | Billet Identification Code |
| BLS | Bureau of Labor Statistics |
| BRAC | Base Closure and Realignment Commission |
| CBO | Congressional Budget Office |
| CMC | Commandant of the Marine Corps |
| CG | Commanding General |
| CO | Commanding Officer |
| COA | Course of Action |
| CONUS | Contiguous United States |
| CY | Calendar Year |
| DC, CD&I | Deputy Commandant, Combat Development & Integration |
| DC, M&RA | Deputy Commandant, Manpower & Reserve Affairs |
| DEP | Delayed Entry Program |
| DOD | Department of Defense |
| DOTMLPF | Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities |
| EFDS | Expeditionary Force Development System |
| ERR | Eastern Recruiting Region |
| ESGM | Enlisted Staffing Goal Model |
| FY | Fiscal Year |
| GD | Geodemographics |
| GIS | Geographic Information System |
| HQ | Headquarters |
| HQMC | Headquarters Marine Corps |
| M&RA | Manpower & Reserve Affairs |

| | |
|---|---|
| MAGTF | Marine Air-Ground Task Force |
| MARFORRES | Marine Forces Reserves |
| MCCDC | Marine Corps Combat Development Command |
| MCD | Marine Corps District |
| MCL | Marine Air-Ground Task Force Capabilities List |
| MCO | Marine Corps Order |
| MCRC | Marine Corps Recruiting Command |
| MCRCO | Marine Corps Recruiting Command Order |
| MCRD | Marine Corps Recruit Depot |
| MCTFS | Marine Corps Total Force System |
| MET | Mission Essential Task |
| MLR | Multivariate Linear Regression |
| MMEA | Manpower Management Enlisted Assignments |
| MOS | Military Occupational Specialty |
| MPP | Manpower Plans, Programs and Budget |
| MROC | Marine Requirements Oversight Council |
| MTF | Monitoring the Force |
| NDAA | National Defense Authorization Act |
| NELS | National Education Longitudinal Survey |
| NLSY79 | National Longitudinal Survey of Labor Force Behavior, Youth, 1979 |
| NPS | Naval Postgraduate School |
| OCONUS | Outside Continental United States |
| OSD | Office of the Secretary of Defense |
| POM | Program Objective Memorandum |
| RS | Recruiting Station |
| RSS | Recruiting Sub-Station |
| SME | Subject Matter Expert |
| SNCOIC | Staff-Non-Commissioned-Officer-in-Charge |
| SQL | Structured Query Language |
| T2P2 | Training, Transient, Prisoner, Patient |
| TFSD | Total Force Structure Division |
| TFSP | Total Force Structure Process |

| | |
|---|---|
| TIGER | Topologically Integrated Geographic Encoding and Referencing |
| TO&E | Table of Organization & Equipment |
| USCB | United States Census Bureau |
| UNS | Universal Needs Statement |
| USAREC | U.S. Army Recruiting Command |
| USPS | United States Postal Service |
| UUNS | Urgent Universal Needs Statement |
| WRR | Western Recruiting Region |
| ZCTA | ZIP Code Tabulation Area |

THIS PAGE INTENTIONALLY LEFT BLANK

# ACKNOWLEDGMENTS

First, I thank my lovely wife and daughters. Rachael, you are a shining example for every woman. Your unconditional love, resolve, and dedicated support continues to inspire my successes. Callie and Brooke, you are both beautiful, smart, and caring girls that will succeed in all of your aspirations—never quit! Thank you for putting a big smile on my face every day of my life. I love you both, and I am proud to be your Daddy.

I also thank both of my parents for instilling the morals, values, determination, and hard work ethic that has served as the foundation for success over my career as a United States Marine. Your parenting, mentoring, and examples have pushed me beyond inconceivable limits.

I thank my nation and service for giving me this opportunity to acquire more skills and to serve the American people in a different and unique capacity. I also appreciate the guidance and lessons learned from all of my current and former leaders.

I must also acknowledge the incredible contributions and sacrifices made by my thesis advisors, Dr. Latika Hartmann and Dr. Marigee Bacolod. Ladies, your relentless commitment and desire to educate the leaders of our nation's warriors is not only commendable but also selfless. Your guidance, constructive feedback, educational lessons, and confidence in my abilities to excel served me well throughout an awesome educational experience here at the Naval Postgraduate School.

I thank Professor Louis Morin of the University of Maine for his great GIS periods of instruction during my undergraduate studies. This thesis would not have been feasible without the skill set I gained from Louis' GIS course.

I also extend my sincere gratitude to Mr. Tim Johnson from M&RA, and Major Stephen Reamy from MCRC, for their rapid responses to requests for data required for this research. In addition, I am very grateful to Michele D'Ambrosio from the Naval Postgraduate School's Thesis Processing Office. Michele's constructive criticisms reminded me that I am merely human.

THIS PAGE INTENTIONALLY LEFT BLANK

# I. INTRODUCTION

> Leaders must have a strong sense of the great responsibility of their office; the resources they will expend in war are human lives.
>
> —Headquarters, United States Marine Corps, MCDP-1, *Warfighting*, 1997, p. 57

## A. OVERVIEW

The successful employment of a crew-served machine-gun, tank, or aircraft relies heavily on the effectiveness of the operators and maintenance personnel. Thus, the storied history of the Marine Corps often serves as a reminder that the most valuable resource on the battlefield is personnel. Regardless of fluctuations to personnel requirements, the Marine Corps' top leaders consistently agree that acquiring high quality enlisted Marines is critical to mission success. In fact, the 37th Commandant of the Marine Corps (CMC) places people at the top of his priority list, stating that

> Marines have historically possessed an innate drive to succeed, to excel in all that they do, including winning in combat. We will sustain this trait and ensure this drive to succeed, excel, and win continues to define our Corps by maintaining **a force of the highest quality, which is smart, resilient, fit, disciplined, and able to overcome adversity. Recruiting and retaining quality men and women of character in today's Corps is our friendly center of gravity and our highest priority** [emphasis in original]. To achieve this end, we must continue to recruit and retain the best men and women, across the changing demographic of the Nation, who are ready and willing to step up and accept the challenge of becoming Marines. (Neller, 2016)

The Marine Corps faces multiple challenges in its attempt to access high quality enlisted personnel. The Corps is susceptible to macroeconomic conditions that affect a young adult's decision to join the military (Mann, 2011). Competition with the civilian labor market forces the Marine Corps to provide pecuniary and non-pecuniary benefits to remain competitive with the civilian sector. In fact, "when the economy is expanding, military recruitment and retention suffers" (Mann, 2011, p. 2). In contrast, recruiting and retention prosper during economic recessions (Mann, 2011). In addition, Marine Corps

recruiting competes with sister services to convince young men and women to join the Marine Corps over the other branches, making it even more challenging to access high quality personnel from a diminished pool if economic conditions are not favorable.

The Marine Corps also faces a shrinking pool of potential recruits due to a diminishing willingness to serve. In a 2015 survey conducted by the Harvard Institute of Politics, "60 percent of the 18- to 29-year-olds polled say they support committing U.S. combat troops to fight ISIS. But, an almost equal number (62 percent) say they wouldn't want to personally join the fight, even if the U.S. needed additional troops" (Khalid, para. 3). Although this poll is not indicative of the entire population, it does illustrate the challenging nature of recruiting individuals from this generation of millennials.

The overall reduction of military manpower and subsequent budget cuts within the Department of Defense (DOD) also makes Marine Corps recruiting efforts more challenging. According to the Office of the Under Secretary of Defense (2009 & 2015), the budget estimates for Marine Corps recruiting, advertising, and examining experienced a sharp decline from $233.7 million in fiscal year (FY) 2011 to $161.8 million in FY 2016—a reduction of 44.4 percent. This decline in budget decreases the human and financial resources available to the Marine Corps to procure the high quality enlisted personnel demanded by the CMC.

The fluctuations of labor markets, recruiting competition among services, and declining budgets all present tremendous challenges for Marine Corps recruiting; however, these challenges should also serve as indicators that the Marine Corps must consistently seek a means to gain a comparative advantage in recruiting high quality enlisted accessions.

The goal of this research is to examine how the geographic positioning of all active duty Marine Corps personnel (recruiting locations, installations, detachments and independent duty stations) effects high quality enlisted accessions, as measured by individuals scores on the Armed Forces Qualification Test (AFQT). This study incorporates geospatial analyses and multivariate statistical analyses to identify the relationship between the presence of active duty Marines and the acquisition of high

quality enlisted Marines. The findings from this study provide Marine Corps manpower and recruiting leadership with potential geospatial and statistical models that help target high quality enlisted accessions.

The primary research question is this: What is the effect of an active duty Marine presence on selecting high quality enlisted accessions? Secondary research questions address other correlates of high quality accessions; namely, do other factors—such as age, race, gender, education, and marital status—affect high quality enlisted accessions? In addition, does variation exist between active (recruiting) and passive (presence of non-recruiting Marine Corps personnel) methods for accessing high quality enlistees?

To answer these questions, we use a quantitative approach. First, we apply a geographic information system (GIS), MapInfo Professional version 15.2, to create geospatial models that capture individual-level enlisted accession data. Using individual data on home of record at the time of enlistment, we create indicators for whether an individual lives within a 10, 25, 50, and 100 mile radius of an active duty Marine Corps presence (i.e., recruiting units, installations, detachments, or independent duty stations), as well as those individuals located outside of a 100-mile radius. Then, multivariate linear regression models estimate the effects of these location indicators and other independent variables on high quality enlisted accessions, as measured by AFQT.

This research presumes, or hypothesizes, that the presence of active duty Marines affects the accessions of high quality personnel. Specifically, we assume that individuals who live beyond a 25-mile radius of any recruiting unit, Marine Corps installation, Marine Corps detachment, or independent duty station affects the accession of high quality enlisted recruits. Economics perhaps play a greater role in the accession decision of recruits from further away places since they receive less exposure to the Marine Corps and the military more generally.

Previous literature indicates several demographic and economic variables that contribute to the procurement of enlisted personnel. Factors such as age, gender, race, education, post-secondary education goals, family income, parental influence (including veteran status), and civilian labor market conditions all typically affect an individual's

propensity to join the military. An analysis of prior research involving geospatial factors finds that recruiter density and market segmentation also play a role in whether an individual joins the military.

This study reveals that geospatial proximity to active duty Marine Corps locations plays a significant effect in high quality enlisted accessions. The GIS models suggest that the majority of Marine Corps enlisted procurements live between 26 and 100 miles from any active duty location. The inclusion of traditional independent variables—such as age, gender, race, education, etc.—within multivariate regression analyses does not disclose any enlightening results; however, the addition of geospatial variables offers insight on distance related factors contributing to high quality enlisted accessions.

In fact, the quality of personnel typically declines as distance increases, except for enlisted accessions located between 11 and 25 miles, and beyond 100 miles, suggesting that the home of record for the majority of high quality enlisted accessions exist in the rural regions of the United States. An analysis of differential selection suggests mixed results for females, African Americans, and high school graduates, depending on their home of record distance from an active duty location. Furthermore, we find that there is a greater probability of accessing exceptionally high quality enlistees if an individual's home of record is located beyond a 100-mile radius from an active duty location.

## B. SCOPE AND LIMITATIONS

The focus of this research revolves around the enlisted population accessed into the Marine Corps from the years 2000–2014. However, the study is scoped down to include only the personnel that joined from areas located within the contiguous United States (CONUS), and therefore excludes individuals joining from Alaska, Hawaii, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, U.S. Virgin Islands, and all foreign nations. In addition, the quantitative analyses are somewhat limited due to a lack of available data. For instance, factors not included in the dataset—such as parent income, parent education, attitudes towards military service, number of dependents at accessions, and regional unemployment rate—may also contribute to high quality accessions within the Marine Corps.

The inclusion of U.S. Census Bureau (USCB) Topologically Integrated Geographic Encoding and Referencing (TIGER) shapefile data also limits the research. This study utilizes USCB ZIP Code Tabulation Area (ZCTA) datasets to geocode individual enlisted accession locations at the ZIP code level. In creating the ZCTAs, the USCB "took the most frequently occurring ZIP code in an area for the ZCTA code" (U.S. Census Bureau, 2015). Although not every ZIP code exits within the ZCTA datasets, the ZCTA code is the same as the ZIP code in most instances (U.S. Census Bureau, 2015), and the researchers maintain the ability to select adjacent ZIP code areas during geocoding procedures.

## C. OVERVIEW OF CHAPTERS

The remainder of this research is organized into five chapters. Chapter II provides institutional and background information on how the U.S. Marine Corps procures enlisted personnel. Chapter III presents a review of relevant literature pertaining to this study. Then, Chapter IV provides an in-depth explanation of the data and methodology. Chapter V discusses the results of the GIS and statistical models. Lastly, Chapter VI offers a summary of the research and recommendations for future studies.

THIS PAGE INTENTIONALLY LEFT BLANK

# II. BACKGROUND

## A. OVERVIEW

This chapter provides institutional and background information on how the U.S. Marine Corps procures its enlisted personnel. The Marine Corps recruiting section offers an in-depth history of Marine Corps recruiting, the mission of Marine Corps Recruiting Command (MCRC), an explanation of MCRC's organizational structure, and passive means for recruiting enlisted personnel. The last part of the chapter presents an overview of the Marine Corps' enlisted procurement procedures, including the Total Force Structure Process (TFSP), the role of the Manpower Plans, Programs and Budget (MPP) Branch, and a general description of the recruiting process.

## B. MARINE CORPS RECRUITING

The principal organization responsible for acquiring enlisted personnel is MCRC. MCRC works closely with the MPP Branch of the Manpower & Reserve Affairs (M&RA) department of Headquarters Marine Corps (HQMC) to accomplish enlisted accessions goals. MPP-20 predicts the enlisted personnel requirements, and subsequently provides MCRC its accession goals for a given time period (initially a fiscal year goal that adjusts on a monthly basis due to active duty attritions).

### 1. History of Marine Corps Recruiting

The inception of Marine Corps recruiting began with the formal adoption of the Continental Marines on 10 November 1775. Following the Continental Congress's approval to establish two battalions of Marines at the onset of the American Revolution, Captain Samuel Nicholas, the first Marine recruiter, convinced the owner of a small drinking establishment to join the fight for freedom against the British. While visiting Tun Tavern in Philadelphia, PA, Nicholas recruited Robert Mullen to join the Marine Corps, establishing a warfighting organization dedicated to protect the values and beliefs of its citizens (U.S. Marine Corps, 2016).

The early years of Marine Corps recruiting did not prove fruitful. In fact, the first Marine recruiters relied on a drummer and fifer as their initial method to attract the attention of potential recruits (Reich & Kozlusky, 1994). Moreover, during the first 130 years of the Marine Corps' existence, conscription did not exist, forcing recruiters to convince men to join strictly voluntarily. The Corps frequently failed to meet approved end-strength requirements due to low pay and minimal enlistment incentives (Reich & Kozlusky, 1994). The accession mindset of early commanding officers (CO) also contributed to low personnel numbers. Detachment commanders only recruited the number of Marines they deemed necessary—often not recruiting at all (Reich & Kozlusky, 1994). A large variance in the authorized end-strengths, and the near-sighted recruiting mentality translated to poor procurement planning for future manpower requirements (Reich & Kozlusky, 1994).

The early part of the 20th century brought change to Marine Corps recruiting. In May 1917, Congress passed the Selective Service Act, requiring all adult males between the ages of 21 and 30 to register for the draft. Perri (2013) asserts that, "the ostensible objective was to choose the men the army [and Marine Corps] wanted, leaving out those who were valuable to the war economy or who favored forms of nonmilitary production" (p. 432). The nation's leaders transitioned military manpower legislation to ensure military end-strengths and the industrial workforce adequately supported the ensuing world war. Although the draft aided recruiting efforts, the Corps extended its reach by providing recruiters with automobiles—the first of all services—and promoting a message about service to country (Reich & Kozlusky, 1994).

At the conclusion of World War I, the number of Americans joining the military trended downwards. With the nation no longer at war, Congress approved the National Defense Authorization Act (NDAA) of 1920 to revert to a voluntary system. Without an imminent threat in the near future, the end-strength requirements also decreased; however, as things heated up in Europe and Japan nearly 20 years later, Marine Corps recruiting personnel found themselves flooded with patriotic Americans prepared to serve their nation (Reich & Kozlusky, 1994). In 1940, Congress reenacted the draft with lotteries at first, and then drafted the oldest members eligible (Perri, 2013). Although the

need to advertise for enlistees quickly diminished, the Marine Corps exploited this new draft era as an opportunity to publicize the elite nature of its service (Reich & Kozlusky, 1994).

During the post-World War II era, Marine Corps recruiting experienced another downward trend. Again, the necessity to maintain wartime end-strength numbers diminished as foreseen national threats decreased. However, as the expiration of the Selective Service Act approached in 1947, President Harry Truman urged Congress to extend the draft. Truman expressed concern about poor peacetime recruiting productivity and the inability to meet military obligations across the world (Ray, 2015). Congress agreed with Truman through the approval of Selective Service Act extensions. During the Korean War, Congress reauthorized the draft under the Universal Military and Service Training Act of 1951, requiring men between ages 18 and 26 to register (Ray, 2015). The draft became an effective recruiting tool for volunteers. In fact, as Perri (2013) notes, "an estimated 40 percent of the volunteers enlisted to avoid the draft" (p. 434).

The draft remained active over the next two decades as the Marine Corps recruiting institutions underwent changes. In 1953, the CMC combined enlisted- and officer-recruiting efforts under seven districts that reported directly to HQMC (Reich & Kozlusky, 1994). Yet again, the end-strength requirements waned as immediate global threats diminished. Nonetheless, the existence of the draft continued to ease Marine Corps recruiting efforts with individuals volunteering to enlist, and with the Korean War in the past, quotas became fairly stabilized (Reich & Kozlusky, 1994). In addition, the Marine Corps improved its recruiting production capabilities by exploiting seasoned staff. Many of the key recruiter billets were filled by tested Marines with six to ten years of experience (Reich & Kozlusky, 1994). Nonetheless, the Corps' recruiters continued to rely on the draft during the Vietnam War era, creating new challenges when the military transitioned to the All-Volunteer Force (AVF) in 1973.

The years following the Vietnam War further necessitated change within the Marine Corps recruiting environment. The eradication of selective service in 1973 forced the Corps to rely on a new recruiting strategy. A newly defined concept developed by Brigadier General Edward B. Meyer, the Corps' first personnel procurement director, and

a former recruiting district CO, focused on the total force recruiting concept (Reich & Kozlusky, 1994). Total force recruiting utilizes a team-oriented approach that integrates M&RA, MCRC, and Marine Forces Reserves (MARFORRES) to facilitate accessions (Commandant of the Marine Corps [CMC], 2009b). These efforts eventually led to a highly productive recruiting force despite the challenges of procuring volunteers without the aid of a draft.

On January 1, 1994, the CMC, General Carl Mundy, established the present-day recruiting organization known as MCRC. Since MCRC's inception, the Corps' recruiting community consistently proves itself as a prosperous organization. In fact, a 2006 Congressional Budget Office (CBO) study reveals that MCRC met or exceeded active and reserve recruiting goals from FY97 to FY06.

### 2. Mission of Marine Corps Recruiting Command

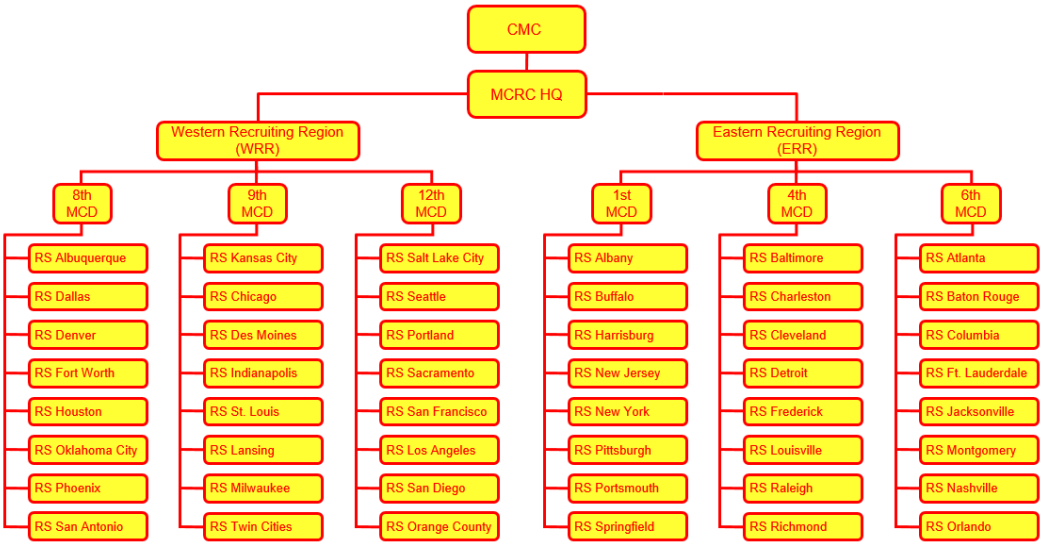
In accordance with Marine Corps Recruiting Command Order (MCRCO) 1100.1 (2011), the mission of MCRC is set forth in the following:

> The ultimate objective of Marine Corps Recruiting Command (MCRC) is the perpetuation of the Marine Corps and the standards of preparedness and military vigor that Marines have upheld since 1775. The immediate impact that recruiting has on the Marine Corps requires that standards for enlistment be strictly set to ensure that future Marines will maintain our tradition of excellence. Accordingly, the mission of the Marine Corps is to Make Marines, Win Battles, and Return Quality Citizens to their communities. [Emphasis in original] (p. 1–4)

### 3. Organizational Structure of Marine Corps Recruiting Command

Under the cognizance of the CMC, the organization of MCRC is divided hierarchically into five subordinate commands. The MCRC headquarters (HQ) sits atop the structure, followed by the recruiting regions, then Marine Corps Districts (MCDs), Recruiting Stations (RSs), and Recruiting Sub-Stations (RSSs). Figure 1 shows the enlisted recruiting organizational structure of MCRC.

Figure 1. MCRC Enlisted Recruiting Organization.
Adapted from Choike & Zeliff (2010).




### *a. CMC*

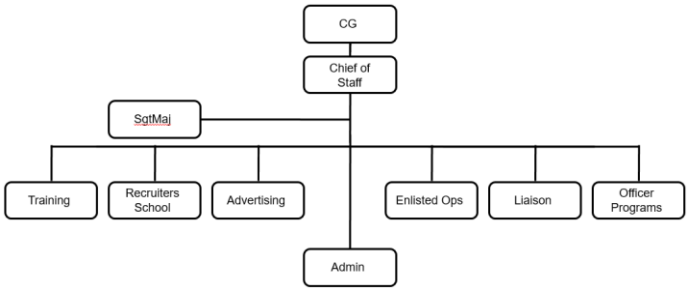
As the component head of the Marine Corps, the CMC is ultimately responsible to the President and Secretary of Defense for accessions and end-strength requirements. However, given the nature of the responsibilities with this position, the CMC delegates the responsibility of accessions to the Commanding General (CG) of MCRC.

### *b. MCRC Headquarters*

The MCRC HQ, based out of Quantico, VA, serves as the primary organization for enlisted and officer accessions for the Marine Corps. The HQ element is comprised of the CG, a two-star (Major General) position, a Chief of Staff, the Sergeant Major, Recruiters School, and multiple staff support sections. Figure 2 depicts the MCRC HQ element. The CG is overall responsible to the CMC for all recruiting matters, while the Chief of Staff executes the CG's intent by managing the MCRC staff. The Recruiter School trains recruiters for follow-on assignments, and the rest of the staff provides administrative and logistical support to ensure the MCRC meets its organizational objectives.

`

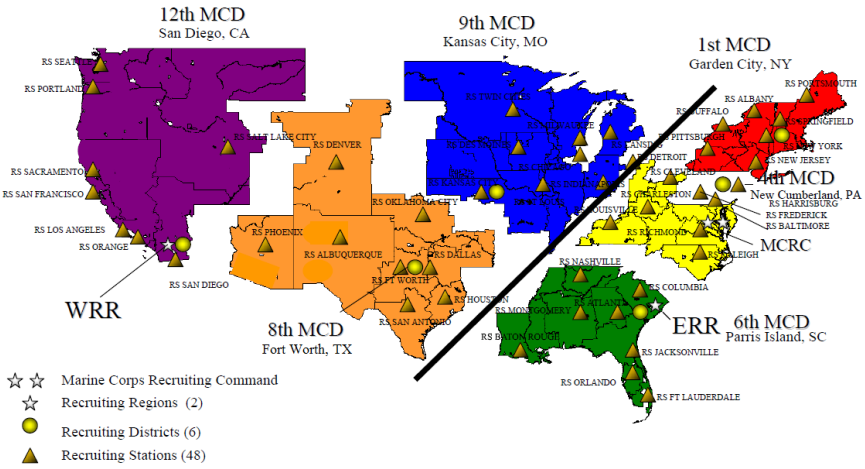
Figure 2. MCRC HQ Structure. Source: Reich & Kozlusky (1994).




### *c. Recruiting Regions*

The Mississippi River divides the Eastern Recruiting Region (ERR) and Western Recruiting Region (WRR). The CGs of the ERR and WRR, both one-star positions, oversee recruit training operations in addition to their recruiting responsibilities. The ERR HQ is located at Marine Corps Recruit Depot (MCRD), Parris Island, SC, and the WRR HQ is based out of MCRD, San Diego, CA. Both the ERR and WRR have staff sections that provide administrative, operational, and logistical support to assist in attaining recruiting and accession goals. The Figure 3 map provides the areas of responsibility (AORs) for each MCRC unit at the MCD level.

Figure 3. Map of MCRC AORs. Adapted from Choike & Zeliff (2010).



### *d. Marine Corps Districts*

Each recruiting region contains three MCDs (six total), and a full-bird Colonel serves as the commander in each MCD. The 1st MCD is responsible for recruiting in the northeastern region of the United States, and its HQ is located in Garden City, NC. The 4th MCD's recruiting AOR stretches across the Mid-Atlantic with the HQ element in New Cumberland, PA. The 6th MCD focuses recruiting efforts throughout the southeast, and its HQ is stationed at MCRD, Parris Island, SC. The 8th MCD HQ is in Fort Worth, TX, and its AOR includes the South-Central region, the Southwest, and the eastern portion of the Mountain region. The 9th MCD's recruiting AOR covers the northern portion of the Mid-West with its HQ in St. Louis, MO. Lastly, 12th MCD's efforts focus on the western part of the Mountain region and the entire Pacific region, with its HQ located in San Diego, CA. MCD staffs consist of administrative, operational and logistical support sections.

### *e. Recruiting Stations*

A total of 48 Recruiting Stations exist throughout the United States. A Major commands each RS, and their senior enlisted advisor is a Sergeant Major. In addition, a senior career recruiter, typically a Master Sergeant with the military occupational specialty of 8412, serves as the RS operations and training chief. The RS staff includes a small cadre of Marines that support administrative, operational and logistical requirements.

### *f. Recruiting Sub-Stations*

Depending on the geographical size and civilian population of a RS's recruiting region, the number of RSSs that fall under a RS ranges between eight and fifteen. A Staff-Non-Commissioned-Officer-in-Charge (SNCOIC) leads the RSS and reports to the RS CO. Canvasing recruiters work closely with the RSS SNCOIC to meet contract and accession goals throughout the FY.

### 4. Passive Measures of Recruiting

The existence of active duty locations, other than recruiting units, serves a means of passive recruiting. Marine Corps installations, detachments, and independent duty locations contain an active duty presence of Marines that frequently participate in local and regional events that passively advertise the Marine Corps. The active duty Marines stationed in these capacities participate in community events, such as the Marine Corps Marathon, Memorial and Veterans Day parades, funeral honors, and sporting events.

## C. MARINE CORPS ENLISTED PROCUREMENT

The Marine Corps enlisted procurement process includes several entities, requiring detailed planning and coordination to meet desired end-strengths. The remainder of this chapter demonstrates the intricacies of procurement by explaining the TFSP, identifying the role of the MPP Branch, and then describing the recruiting process.

### 1. Total Force Structure Process

The first thing to understand about enlisted personnel procurement requires a review of the Marine Corps' TFSP. The purpose of the TFSP is to "translate needed organizational capabilities into force structure solutions, measure the costs providing those capabilities, and resource capabilities consistent with financial resources available to the CMC" (CMC, 2009a, p. 1–1). The TFSP is a multi-phase process that incorporates inputs, analysis, and outputs to determine manpower and equipment requirements.

The first phase of the TFSP is the input phase. The input phase utilizes input products from the Expeditionary Force Development System (EFDS) to develop top-down planning guidance with subsequent bottom-up refinements. The intent of the input phase is to produce tasks, conditions, and standards that facilitate mission accomplishment—the Marine Air-Ground Task Force (MAGTF) Capabilities List (MCL). The MCL is comprised of Mission Essential Tasks (METs) that serve as the primary driving force behind the TFSP.

The second phase of the TFSP is the analysis phase. Marine Corps Combat Development Command (MCCDC)/Deputy Commandant, Combat Development &

Integration (DC, CD&I) analyzes whether or not Marine Corps units adequately perform according to prescribed tasks, conditions, and standards. The findings from this analysis identify the needs required for the Total Force Structure Division (TFSD) to make recommended changes to Tables of Organization and Equipment (TO&E), including all Universal Need Statements (UNS), or Urgent UNS (UUNS).

The third phase of the TFSP is the output phase. During this phase, Subject Matter Experts (SMEs) identify DOTMLPF (doctrine, organization, training, materiel, leadership, personnel, and facilities) solutions to devise recommended courses of action (COAs). Next, the Marine Requirements Oversight Council (MROC) analyzes the COAs, makes appropriate adjustments, and then briefs the CMC. Once the CMC selects a COA for implementation, MCCDC drafts new TO&Es, providing the basis for needs during the next Program Objective Memorandum (POM). The principal product, the new TO&Es, provides subordinate HQMC commands with the manpower, equipment, and training requirements necessary to take action on future acquisitions, accessions, and training policies (refer to Appendix A for a TO&E example). Figure 4 provides a depiction of the three-phase approach of the TFSP.

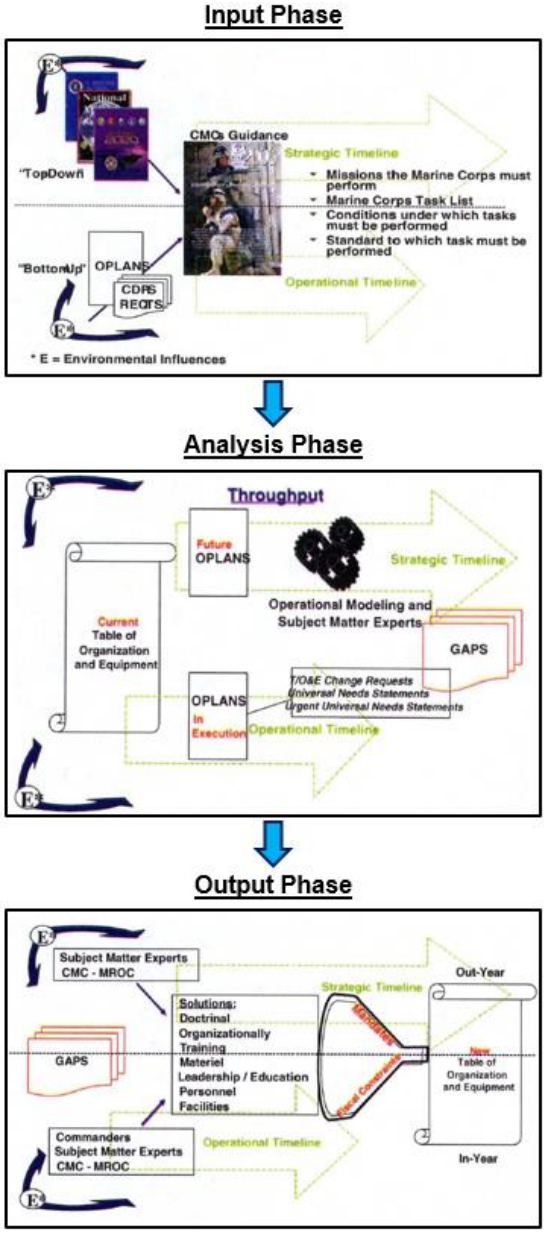
### 2. MPP Branch

Once the new TO&Es receive approval for implementation, DC, CD&I produces an Authorized Strength Report (ASR), and then the onus of manning and staffing lies with the Deputy Commandant, M&RA (DC, M&RA). The MPP Branch of M&RA is responsible for producing manpower plans for both officers (MPP-30) and enlisted personnel (MPP-20). According to the MPP-20 (2016) website, the following explains the mission of the MPP Branch:

> Manpower Plans, Programs & Budget (MPP) Branch is responsible for assisting the Director MP Division in implementing the Commandant's policies and decisions by formulating manpower plans for both officer and the active duty enlisted force. These plans include end strength, enlisted testing, career retention, exit surveys, inventory, budget, POM issues, and promotions. MPP is also responsible for plans/mobilization of reservists and T/O change requests concurrence/nonoccurrence.

MPP-20 creates the Corps' enlisted manpower plans, which include the required number of enlisted accessions for each FY. "These plans include enlisted end strength, career force, enlisted inventory, first term inventory, and promotions" (MPP-20, 2016). Upon identifying the required amount of accessions, MCRC is tasked with recruiting enlisted personnel to assist in meeting end strength requirements.

Figure 4. Marine Corps TFSP. Source: CMC (2009a).



### 3. Recruiting Process

Upon receiving personnel procurement requirements, MCRC allocates recruiting quotas using the trickle-down effect, eventually reaching the RSS level. Although MCRC Order (MCRCO) 1100.1 (CG, 2011) serves as the guiding document for recruiting procedures, Griesmer (2006) offers a simple explanation of the basic processes involved with recruiting enlisted Marines. Griesmer (2006) delineates the difference between contracts and accessions, pointing out that contracts relate to individuals that signed a contract to serve in the Corps but remain in the Delayed Entry Program (DEP) awaiting shipment to recruit training. In contrast, accessions represent the individuals that actually ship to recruit training, becoming part of the Training, Transient, Prisoner and Patients (T2P2) manpower inventory. Essentially, contracting is MCRC's management strategy to fulfill future accessions (Griesmer, 2006).

The means of acquiring enlisted personnel involves a six-step process. Again, Griesmer (2006) offers a simple approach to explaining the process using the following steps:

1. Obtain names: Gain the names of potentially qualified enlistees to contact.
2. Prospect: Get in contact with previously acquired names.
3. Screen: Determine enlistment eligibility and eliminate disqualified individuals.
4. Sell: Persuade qualified individuals to join.
5. Process: Complete contract and ensure the prospective enlistee meets moral, mental, and physical requirements and examinations.
6. Ship: Prepare poolees (signed enlistment contract personnel) mentally and physically and ship them to recruit training.

A review of MCRCO 1100.1 (2011) provides an important understanding of the eligibility criteria required to enlist in the Marine Corps. First, the applicant's age must range from 17 and 28 (17-year-olds require parental consent). Second, the enlistee is a U.S. citizen, Native American, resident of a U.S. territory, or an alien with valid green card. Third, the applicant is not the sole provider of a dependent (whether single or divorced). Fourth, the applicant meets the education criteria of the three-tiered system in

Appendix B. Fifth, the applicant cannot acknowledge dependency on drugs or alcohol nor display a pattern indicating dependency. Sixth, the applicant meets the minimum aptitude test scores. Seventh, the applicant meets or exceeds minimum physical aptitude standards. Last, the applicant does not violate any of the conduct or behavior standards (including appearance such as tattoos and piercings).

Although enlistment waivers exist, the aforementioned eligibility standards provide valuable information for recruiters to utilize as a baseline during searches for potential enlistees. Furthermore, the preceding eligibility criteria does not include all of the details that may disqualify an individual from enlisting in the Marine Corps. For additional information on waivers and eligibility criteria, refer to MCRCO 1100.1 (2011).

## D. SUMMARY

MCRC is the primary organization for recruiting enlisted personnel; however, the presence of active duty personnel at installations, detachments, and independent duty stations also serve as a form of passive recruiting. This study incorporates these efforts in the development of geospatial and multivariate regression models to estimate the effect of active duty presence on high quality enlisted accessions.

# III. LITERATURE REVIEW

This chapter provides a review of the relevant literature pertaining to this study. The first section covers fundamental concepts of military manpower. Then, section two provides analyses of previous empirical studies on enlisted accessions. Section three recapitulates prior applications of GIS techniques in marketing and recruiting, and the chapter concludes with a brief summary of the literature.

## A. FUNDAMENTALS OF MILITARY MANPOWER

### 1. Labor Market Economics

With President Barack Obama's announcement of the end of the global war on terrorism in 2013 (Shinkman, 2013) and the federal sequestration, military downsizing resulted in major changes to mission requirements and, consequently, organizational manpower needs. From 2012 to 2015, the Marine Corps reduced its active component by nearly 10% (202,100 to 184,100) due to conflicts ending in Iraq and Afghanistan (Marine Corps University, 2016; End Strength, 2015). As the Marine Corps considers its future manpower and recruiting focus, it is important to consider the theoretical frameworks for labor markets.

Two popular means for matching individuals to jobs include distributed markets and hierarchical planning (Ramirez & Park, 2003). The distributed market-based approach utilizes labor supply and demand to match individuals to jobs, while the hierarchical approach relies on the centralized placement of workers. In the Marine Corps, matching is still very much hierarchical in nature; however, most private firms rely on the distributed market-based method.

The preponderance of civilian labor markets heavily rely on indicators to align employees to jobs. As firms identify jobs requiring new employment, they try to match qualified candidates to particular positions at a specified wage deemed. Conversely, potential employees focus on finding an enjoyable job that is at or above their desired or reservation wage. Essentially, a worker's concerns rest with maximizing their utility, with particular focus on the pecuniary and nonpecuniary aspects of the job (Ehrenberg &

Smith, 2012). A firms' motivation, however, focuses on profit maximization, so the employer tends to staff positions at the lowest feasible cost. Figure 5 provides a graphical depiction of the fundamental interactions that occur within a market-based labor market. As labor supply increases (shifting the supply curve to the right from the equilibrium at $W_e$), a firm's willingness to pay decreases from wage $W_e$ to wage $W_1$. On the other hand, as a firm's labor demand increases (shifting the demand curve to the right from $W_e$), the firm is willing to increase employee wages from $W_e$ to $W_2$.

Figure 5. Distributed Market-Based Model. Source: Ehrenberg & Smith (2012).


Conversely, the Marine Corps' hierarchical approach relies on manpower management personnel to assign individuals to specific TO line numbers for each command. Since there is no lateral entry into the U.S. military, as a Billet Identification Code (BIC) becomes vacant, manpower managers match a MOS-trained Marine to that line item to ensure the command is adequately staffed for its mission. Although Manpower Management Enlisted Assignment (MMEA) monitors attempt to match Marines' assignments based on their individual preferences, the priority rests with manpower management sourcing vacant billets that accommodate the needs of the Marine Corps.

`

### 2. Defense Manpower Supply

The supply of defense manpower fluctuates in cycles depending on various economic and socio-demographic trends. During post-war periods and economic recessions/expansions, the military labor market experiences shifts in manpower supply. Rosen (1986), Warner and Asch (1995) attribute these shifts to standard occupational choice theory regarding the civilian and military sectors (Asch, Hosek, & Warner, 2007), suggesting individuals choose to join the military by comparing the pay and non-pecuniary benefits of each labor market. However, other contributing factors also exist, such as college attendance rates and college expectations, population of veterans positively recommending service, retirement, bonuses and allowances, advertising, recruiters, and educational benefits (Asch et al., 2007).

The evolution of military pay and changes to relevant elasticities also contribute to an individual's choice to serve in the military. Asch et al. (2007) suggest people choose to join only if $U^M = W^M + \tau^M > U^C = W^C + \tau^C$, or $W^M - W^C > \tau^C - \tau^M$. In this equation, $U^M$ and $U^C$ represent the utility of each choice, $W^M$ and $W^C$ signify military and civilian wages, respectively, and $\tau^M$ and $\tau^C$ are the value of non-pecuniary benefits and costs in each sector. Simply stated, an individual joins the military only if the utility of military employment exceeds the utility of civilian employment, or the benefit derived from pay differences exceeds the opportunity cost surrendered by forgoing civilian life, $\tau = \tau^M - \tau^C$ (Asch et al., 2007). As preferences for joining become more diverse due to changes in the national security environment, the variance in $\tau$ increases, and the manpower supply becomes less elastic, making manpower goals more challenging (Asch et al., 2007). In addition, during periods of economic expansion, a booming civilian labor market attracts high quality youth, and reduces the potential for accession of high quality recruits (Asch et al., 2007).

## B. EMPIRICAL STUDIES ON ENLISTED ACCESSIONS

Since the implementation of the AVF in 1973, the trends for individuals joining the military fluctuate based on a variety of factors, including economic conditions, socio-economic backgrounds, and the choice to continue education, or enter the civilian labor

force. Thus, we delineate factors affecting an individual's propensity to join the military through an analysis of past studies that incorporate multivariate analysis methods to predict enlisted accessions.

In 1985, Hosek and Peterson conducted a study on the enlistment choices of young men for the Office of the Secretary of Defense (OSD). The focus of their research included two subpopulations: 1) high school seniors; and, 2) nonstudent [high school] graduates. These two groups comprise the majority of the high-quality recruiting pool often targeted by recruiters (i.e., individuals ranging in age from 17 to 22 years old that scored in the upper-half on the AFQT). Table 1 highlights Hosek and Peterson's (1985) twelve supply hypotheses and three demand hypotheses on propensity to enlist. The plus symbols indicate a positive effect, the minus symbols represent a negative effect, and the question mark shows a neutral stance due to difficulties for interpretation.

Table 1. Hypotheses on Propensity to Enlist. Source: Hosek & Peterson (1985).

| **SUPPLY HYPOTHESES** | | |
|---|---|---|
| | Expected Effect on Propensity to Enlist | |
| Explanatory Variable | Seniors | Graduates |
| Learning Proficiency | | |
| Age when senior | + | + (Weaker) |
| AFQT | - | - (Weaker) |
| Ability to finance school | | |
| Live at home | - | - (Weaker) |
| Family income | - | - (Weaker) |
| Number of siblings | + | + (Weaker) |
| Education experience | | |
| Expects more education | - | + |
| Mother's education | ? | ? |
| Employment situation | | |
| Hourly wage | - | - (Stronger) |
| Weekly hours | ? | - |
| Months since school | N.A. | - |
| Months on current job | - | - (Stronger) |
| Month not employed | ? | + |
| Race/ethnicity | | |
| Black | + | + |
| Hispanic | + | + |
| **DEMAND HYPOTHESES** | | |
| | Expected Effect on Propensity to Enlist | |
| Explanatory Variable | Seniors | Graduates |
| Recruiter density | + | + |
| Market share of seniors and recent graduates | 0 | - |
| AFQT category IV | - | - |

Hosek and Peterson's (1985) quantitative study uses the 1979 DOD survey of personnel entering military service (AFEES) and data from the 1979 National Longitudinal Survey of Labor Force Behavior, Youth (NLSY79) to develop multivariate logit models that estimate the enlistment probabilities for seniors and graduates. The researchers estimate two variants of the model to capture "within-segment differences in behavior" (Hosek & Peterson, 1985, p. 22). The first model stratifies observations by education expectations to delineate potential recruits versus college-bound individuals. The second model separates observations by AFQT group (upper [50th to 99th percentile] and lower [10th to 49th percentile]) to differentiate the quality of enlistees.

Hosek and Peterson (1985) conclude that the enlistment decisions of high school seniors and high school graduates differ significantly depending on determinants. Particularly, high school graduates "appear more sensitive to work-related variables such as employment status, wage rate, labor force experience, job tenure, and if not currently employed, duration of joblessness" (Hosek & Peterson, 1985, pp. v-vi). Seniors, however, "appear more sensitive to education-related variables representing learning proficiency [as measured by AFQT], ability to finance further education, and parental influence" (Hosek & Peterson, 1985, p. vi).

A 1995 Naval Postgraduate School (NPS) thesis by Chung presents a meta-analysis on high quality recruiting enlistments using previous research. This quantitative thesis relies on military recruiting data from FY81 through FY89, and labor market data, to develop a random effects meta-analysis model to analyze the variation of published elasticities of recruiting efforts and labor market conditions. Chung posits three major factors affecting high quality enlistments: 1) advertising, 2) recruiters, and, 3) unemployment rate. Chung (1995) concludes that both advertising and the number of recruiters in a given area positively affect the likelihood of accessing high quality recruits; however, unemployment rate does not appear to significantly affect the production of high quality enlistments.

Using data from the National Educational Longitudinal Survey of 1988 (NELS), Kilburn and Klerman (1999) estimate a model of individual enlistment decisions for the OSD and the U.S. Army's Deputy Chief of Staff for Personnel. Other variables in their model include "race and ethnicity, aptitude, plans for marriage and education, family income, and various parental characteristics" (Kilburn & Klerman, 1999, p. ix). The goal of this research is to estimate the degree to which the dependent variable (enlistment probability) changes given the marginal effects of each independent variable (Kilburn & Klerman, 1999).

Moreover, the Kilburn and Klerman (1999) study analyzes the same two groups of young men presented in the Hosek and Peterson (1985) study (seniors and graduates). However, the former researchers update Hosek and Peterson's (1985) logistic regression model using three approaches. First, the NELS data allow Kilburn and Klerman (1999) to estimate the earlier model using 1990s individual enlistment decisions. Second, the authors include additional variables, capturing early 1990s social trends, to derive a more useful model (Kilburn & Klerman, 1999). Lastly, instead of a two-choice model of enlistment, Kilburn and Klerman (1999) develop and estimate a three-choice model to predict three potential outcomes: 1) enlist; 2) further education; or, 3) join the workforce.

Kilburn and Klerman (1999) show that the enlistment decisions of male seniors and graduates from the early 1990s remain consistent with the findings in Hosek and Peterson's (1985) study. The additional variables present in the Kilburn and Klerman (1999) study include parent in the military, marijuana use, respondent or friend had been arrested, English not first language, and average in-state tuition. They find that graduates remain sensitive to work related variables in their enlistment decision, while seniors' sensitivity exists with education and family related variables. The inclusion of the aforementioned social trend variables reveal that a senior's propensity to enlist is substantially lower if English is not their first language, while all of the other newly included variables appear insignificant (Kilburn & Klerman, 1999). However, they find that a graduate's likelihood to enlist increases if their parent is in the military, or if the graduate or a friend have been arrested. Thus, prior exposure to the military has a positive effect on enlistment. This thesis follows up on this idea to test if any geographical

exposure to the Marine Corps via recruiting stations or other active duty locations affects the quality of individuals that enlist.

In their attempt to find out who chooses military service, Bachman, Freedman-Doan, O'Malley, and Segal (2000) report separate bivariate and multivariate regression models for men and women using nationwide cross-sectional survey data drawn from the Monitoring the Future (MTF) project. The study covers select high school senior cohorts from 1984–1991, following many of these individuals into young adulthood using longitudinal panel data to determine those that enlist (Bachman et al., 2000). The initial survey asks students in their senior year their likelihood of either joining the military or earning an undergraduate degree, using a Likert-type scale with the following response alternatives: "definitely won't, probably won't, probably will, and definitely will" (Bachman et al., 2000, p. 5). The follow-up questionnaire seeks the possibility of respondents' intentions to "serve on active duty in the armed forces, attend a four-year college, and graduate from a four-year college program" (Bachman et al., 2000, p. 5). The response alternatives for the latter survey include "I'm doing this now, I have done this, definitely won't, probably won't, probably will, and definitely will" (Bachman et al., 2000, p. 5).

Bachman et al. (2000) design this study using a two-stage approach. "The first stage focused on the impacts of family, demographic, and educational background. The second stage examined the impacts of attitudes, values, and behaviors, both with and without controls for the background factors" (Bachman et al., 2000, p. 6). This study enhances previous research by treating both propensity to join and actual enlistment (one to two years after high school) as dependent variables. Bachman et al. (2000) conclude that African Americans, individuals from the Southern region of the U.S., homes with fewer parents, lower levels of parental education, lower high school grade average, and no plans to attend college all increase propensity to join the military. Bachman et al. (2000) also find that the results for those who actually enlist are similar to those likely to enlist, except for the number of parents and regional variables. The number of parents indicates that enlistment rates increase slightly for men with one parent, and the regional variable does not indicate a significant effect on enlistment.

The impacts of attitudes, values, and behaviors indicate that attitudes about the military (i.e., how good the military does for the nation, whether military spending is too low or too high, and whether the military should have more or less influence) reveals a positive correlation with propensity to enlist and actual enlistment (Bachman et al., 2000). In addition, Bachman et al. (2000) find a negative correlation between the propensity to enlist and the belief that the U.S. should only go to war to defend itself; however, agreement with the notion that service members should always obey orders reveals a positive correlation with propensity to enlist, but neither of these variables correlate with actual enlistment. Expectations of the workplace show a positive relationship with both propensity to enlist and enlistment, while having a job that requires frequent house moves exhibits a negative relationship. Bachman et al. (2000) conclude that the aforementioned results also hold true when controlling for family, demographic, and educational background. Lastly, all substance use measures show low relations with both propensity and enlistment (Bachman et al., 2000).

Asch et al. (2007) conduct an analysis of the previous literature to reveal variable trends contributing to enlisted supply models. DOD survey data from 1990 to 1998 reveal that the number of high school seniors intending to definitely, or probably, join fell by approximately one-third (Asch et al., 2007). This study highlights two approaches used to model enlistment supply. The first method specifies a logit or probit model of individual enlistment decisions, including demographics (i.e., age, family background) and environmental characteristics, such as location, to predict the probability of youth enlistment versus civilian opportunities, mirroring Hosek and Peterson's (1985) study (Asch et al., 2007). The second approach comes from Kilburn and Klerman's (1999) research, where a third outcome variable (decision to attend college) is included in a multinomial logit model.

The first two models reiterate our aforementioned review of multivariate studies; however, Asch et al. (2007) presents a third approach to specify an aggregate enlistment model. As of 2007, the U.S. Army assumes Dertouzos' (1985) model as an adequate means to predict enlistment supply (Asch et al., 2007). The linear equation that estimates this model is given as $\ln H = \lambda \ln L + \beta \ln X + \ln E$ (Dertouzos, 1985), where $H$ is the number

of high-quality recruits in a given geographic area in a specific period, $L$ is the number of low-quality recruits, $X$ is a vector of variables relating to recruiting marketing, and $E$ is the effort of recruiters. Given recruiters face monthly quotas, $Q_H$ and $Q_L$, for high and low-quality enlistees, respectively, Asch et al. (2007), suggests recruiters choose the levels of $H$ and $L$ that maximize utility. Additionally, individual recruiter effort is a function, $\ln E = \gamma_1 \ln(H/Q_H) + \gamma_2 \ln(L/Q_L)$, and therefore provides the two enlistment supply equations in Figure 7 (Asch et al., 2007).

Figure 6. Enlistment Supply Model Equations. Source: Asch et al. (2007).

$$\ln H = \alpha_1 \ln L + \alpha_2 \ln X + \alpha_3 \ln Q_H + \alpha_4 \ln Q_L$$

$$\ln L = \Theta + \pi_1 \ln X + \pi_2 \ln Q_H + \pi_3 \ln Q_L$$

The estimation of the equations in Figure 6 allow manpower management personnel to identify coefficient estimates for $\gamma_1$ and $\gamma_2$, providing pertinent structural parameters $\lambda$ and $\beta$ (Asch et al., 2007). In addition, Asch et al. (2007) notes, "substituting the second equation into the first gives a reduced form equation for high-quality enlistments. In fact, most studies of high-quality enlistment supply have estimated the reduced equation for $\ln H$ and not the structural model in equation system (1)" (p. 1082).

The literature reveals several variables that contribute to an individual joining the military. The factors that matter the most across these studies include the following: age, race, gender, education, workforce conditions, and parental influence. The research performed by Asch et al. is perhaps the best study to relate to this research because it includes geographic location.as a factor for prediction.

## C. APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS

GIS techniques provide military and business leaders with a unique and beneficial analysis tool. A GIS enables its practitioners to convert tabular data into valuable geospatial insight, assisting the organization to not only achieve its objectives, but also gain a potential comparative advantage. For example, using a GIS with Bureau of Labor

Statistics (BLS) and/or U.S. Census Bureau tabular data, firms can develop optimal target areas for sales, advertising, or even employee recruiting.

In a 1989 article, Sleight and Leventhal explore the advantages of geodemographics (GD) in marketing research and explain various applications using case studies. Sleight and Leventhal (1989) find that incorporating raw census data, derived census variables (i.e., wealth), market specific discriminators (e.g., financial pinpoint), and neighborhood classifications into marketing models improves targeting of the right consumer. In addition, Sleight and Leventhal (1989) assert that "[t]he GIS approach enables a marketing company to build a model of latent demand within areas (whatever units of area are convenient), and to examine supply points (stores, branches, or alternative channels, such as direct mail) accordingly" (p. 99). Lastly, Sleight and Leventhal (1989) conclude that the adoption of GIS is the best way to organize and analyze geographic-based information.

Using a thorough literature review and in-depth analysis, Faulds and Gohmann (2001) offer potential solutions to help solve GD modeling issues within the United States Army Recruiting Command (USAREC). Faulds and Gohmann (2001) propose a segmentation model that helps identify geographic clusters (recruiting territories) that possess similar demographic and socioeconomic characteristics. This type of model provides the Army, and potentially other services, a more accurate means to establish organizational goals for recruiting. The model is also capable of assisting decision-makers in properly allocating scarce resources, such as recruiters.

Faulds and Gohmann (2001) also develop a multiple regression model to estimate the effects on production (signed contracts) within the clusters to illustrate the benefits of adopting a segmentation model into recruiting operations. The multiple regression models include ten independent variables that support the Army Recruiting Command Headquarters' strategy for managing contract production. The most notable independent variable is 'full-time recruiter' (statistically significant in all twelve models), and the model's adjusted R-square values range from a low of 0.65 to a high of 0.93. The results of the regression models indicate a high correlation between full-time recruiters and

production, and therefore suggests that the segmentation model serves as an accurate method for sourcing recruiters to low-producing regions.

Doh and Hahn (2008) present spatial methods in strategy research, arguing the necessity to integrate broad and current methods for modeling spatial data in empirical research. This study also reiterates the importance of Tobler's (1970) first law of geography: "everything is related to everything else, but near things are more related to each other" (as cited in Doh & Hahn, 2008, p. 666). The research of Doh and Hahn (2008) focuses on data aggregated by region because it serves as the predominant method employed by strategy researchers.

Upon reviewing multiple studies from the *Strategic Management Journal*, Doh and Hahn (2008) find that previous strategy research fails to capture the effect of spatial autocorrelation. According to Doh and Hahn (2008), spatial autocorrelation indicates that "dependence may arise econometrically from measurement error which spills over from one area to another, or by the mutual influence of proximal areas on each other" (p. 667). They also suggest, "failure to account for spatial autocorrelation leads to incorrect and misleading inferences…when time-series data [is] used with non-time-series methods" (p. 671). As a result, Doh and Hahn (2008) conclude that researchers must utilize the Moran statistic as a measure of spatial autocorrelation to account for residuals in a linear regression model. The econometric analyses in the subsequent chapters will employ various strategies to account for spatial correlation.

## D. SUMMARY

Previous multivariate studies on enlisted accessions indicate the importance of including demographic, economic, and geographic variables in regression models to estimate whether an individual chooses to join the military. Prior research demonstrates the necessity to include gender, race, age, education, marital status, and employment conditions for inclusion in multivariate models. The inclusion of a GIS as an analytical tool provides great utility to manpower decision-makers. Therefore, we incorporate distance variables into our multivariate regression estimates to contribute new independent variables to the enlisted accession pool of research.

THIS PAGE INTENTIONALLY LEFT BLANK

# IV. DATA AND METHODOLOGY

The quantitative nature of this study requires bringing together multiple datasets to answer the research questions. To perform geospatial analyses, we begin with cross-sectional data on all individual Marine Corps enlisted accessions from 2000–2014. We also develop another pooled cross-sectional dataset by merging a MCRC unit locations dataset with a self-constructed dataset that includes all other active duty Marine Corps locations (installations, detachments, and independent duty stations) within CONUS. In this chapter, we begin by describing the enlisted data and then the Marine Corps location data.

## A. CROSS-SECTIONAL DATA

### 1. M&RA

We solicited the Marine Corps enlisted accession data from the M&RA department of HQMC. These data include individual information on all enlisted accessions in each calendar year (CY) from 2000 to 2014. The original enlisted accessions dataset includes 466,362 total observations with a total of 25 variables. Table 2 shows the original number of observations by CY and the descriptive statistics for the 15-year period of enlisted accessions.

M&RA also provided the researchers with a cross-sectional dataset that captures the geographical locations for all MCRC units from January 1, 1950, through June 1, 2016. These data include MCRC locations currently open and locations previously closed. The original MCRC locations dataset contains a total of 2,911 observations. Table 3 displays the total number of MCRC location observations by unit type.

Table 2. Number of Observations in the Original Enlisted Accessions Dataset.

| CY | Observations |
|---|---|
| 2000 | 29,401 |
| 2001 | 30,390 |
| 2002 | 31,362 |
| 2003 | 31,595 |
| 2004 | 30,759 |
| 2005 | 31,720 |
| 2006 | 31,685 |
| 2007 | 35,228 |
| 2008 | 37,805 |
| 2009 | 31,085 |
| 2010 | 27,120 |
| 2011 | 29,346 |
| 2012 | 31,235 |
| 2013 | 31,594 |
| 2014 | 26,037 |
| **Total** | **466,362** |
| Mean | 31,091 |
| Standard Deviation | 2,820 |
| Min. | 26,037 |
| Max. | 37,805 |

Table 3. Observations by Unit Type in the Original MCRC Locations Dataset.

| Unit Type | Observations |
|---|---|
| MCRC HQ | 1 |
| Recruiting Region | 2 |
| MCD | 7 |
| RS | 92 |
| RSS | 2,330 |
| OSS | 479 |
| **Total** | **2,911** |

### 2. U.S. Census Bureau

The need to geocode locations by ZIP code necessitates the acquisition of geospatial datasets that depict the geographic boundaries for each ZIP code. To facilitate this, we download TIGER shapefiles from the United States Census Bureau (USCB, 2016) website. Although the USCB does not offer ZCTA files for each accession year involved in this study, we downloaded the ZCTA files available for every applicable CY.

Each ZCTA dataset contains eight variables, but the ZIP code variable is the only variable required to perform geocoding for this study.

### 3. Marine Corps Enlisted Accession Data

Next, we cleaned the ZIP code location information for the home of record ZIP code collected for each individual accession. The home of record ZIP code fields were formatted to capture all five digits of the ZIP code. Then, each blank or invalid home of record ZIP code fields were identified. All of the ZIP codes that appeared false (i.e., 00000, 11111…88888, 99999) were considered invalid unless proven otherwise by querying the United States Postal Service (USPS) ZIP code lookup database on the USPS website (https://tools.usps.com/go/ZipLookupAction_input). If a record had an invalid or blank home of record ZIP code, but had a valid city and state, we queried the USPS database to obtain a ZIP code. If a valid ZIP code was returned, the ZIP code was entered into the record's home of record ZIP code field. Upon completing the aforementioned procedures, observations that still had a blank or invalid home of record ZIP code field entry were deleted.

Finally, we analyzed the HOR_STATE_CODE variable to identify individuals that accessed outside continental United States (OCONUS). If the HOR_STATE_CODE field contained AD, AK, AM, AU, BA, BR, CE, CU, FE, GE, GU, HA, HI, LO, NO, PH, PU, IC, IR, IT, JA, ST, TA, TH, TR, UN or VI, the record got deleted, assuming that the state code indicated either an invalid state code, or a location positioned OCONUS. Table 4 indicates the results of scrubbing both the home of record ZIP code and HOR_STATE_CODE fields, plus the enlisted accession observations included into the GIS models by CY. Although the results of scrubbing these data decreases the total number of original enlisted accession observations from 466,362 to 452,399, 97.01% of the total population is captured in the GIS model.

Table 4. Enlisted Accession Observations included in the GIS Model by CY.

| CY | Blank Observations | Invalid Observations | OCONUS Observations | Observations for GIS Model | Retained from Original |
|---|---|---|---|---|---|
| 2000 | 122 | 11 | 235 | 29,033 | 98.75% |
| 2001 | 112 | 4 | 245 | 30,029 | 98.81% |
| 2002 | 9 | 4 | 269 | 31,080 | 99.10% |
| 2003 | 6 | 3 | 313 | 31,273 | 98.98% |
| 2004 | 9 | 1 | 311 | 30,438 | 98.95% |
| 2005 | 5 | 1 | 316 | 31,398 | 98.98% |
| 2006 | 9 | 0 | 349 | 31,327 | 98.87% |
| 2007 | 5 | 0 | 396 | 34,827 | 98.86% |
| 2008 | 44 | 1 | 380 | 37,380 | 98.88% |
| 2009 | 1,170 | 0 | 210 | 29,705 | 95.56% |
| 2010 | 2,301 | 0 | 197 | 24,622 | 90.79% |
| 2011 | 2,953 | 0 | 190 | 26,203 | 89.29% |
| 2012 | 2,275 | 1 | 308 | 28,651 | 91.73% |
| 2013 | 462 | 1 | 362 | 30,769 | 97.39% |
| 2014 | 80 | 0 | 293 | 25,664 | 98.57% |
| **Total** | **9,562** | **29** | **4,374** | **452,399** | **97.01%** |

## 4. MCRC Unit Location Data

An initial perusal of the MCRC location data highlights multiple issues for this study. First, the dataset includes MCRC unit locations existing from January 1, 1950 to June 1, 2016. Given the enlisted accession data only spans from CY 2000 to CY 2014, the only MCRC location data of interest falls between these same years (CY00 to CY14). Second, several MCRC unit locations contain duplicate records due to the opening and closing of locations over a 66-year period. Third, this dataset includes OCONUS recruiting locations. Finally, the dataset includes Officer Selection Stations (OSS). As a result, all of the MCRC location observations not applicable to this study were deleted.

Although Officer Selection Stations (OSS) do not actively attempt to recruit enlisted personnel, the members of these units maintain direct connections to the enlisted recruiting units, facilitating an active means for accessing enlisted personnel. Therefore, this study incorporates OSS within the analysis. Table 5 displays the variable names and descriptions from the MCRC unit locations dataset. An asterisk at the end of a variable name indicates a variable of interest that underwent data cleaning.

Table 5. Variables included in MCRC Location Dataset.

| Variable Name | Description |
|---|---|
| ORGANIZATION_ID* | Organization ID assigned by MCRC |
| REGION | MCRC region (ERR or WRR) |
| DISTRICT | MCD |
| RECRUITING_STATION | RS |
| RECRUITING_SUB_STATION | RSS |
| ISOPEN* | Indicates open (Y) or closed (N) |
| MCRC_LONG_NAME | Long name of MCRC unit |
| REG_LONG_NAME | Long name of MCRC region |
| DIST_LONG_NAME | Long name of MCD |
| ORG_TYPE | Type of Organization (H, R, D, RS, RSS, or OSS) |
| MCC_CODE | Monitor Command Code for Unit |
| STREET | Street address for unit |
| STREET2 | Supplement street address information |
| CITY | City of unit |
| STATE_CODE* | State of unit |
| ZIP_CODE* | ZIP code of unit (5-digit) |
| DEFAULT_MEPS | Default Military Enlistment Processing Station |
| EFFECTIVE_DATE* | Effective date of opening or closing |

The initial scrub of MCRC unit location data identified RS, RSS, and OSS observations (all other MCRC organization types existed within the CONUS) located OCONUS using the STATE_CODE variable. Records in OCONUS locations (Alaska, Guam, Hawaii, and Puerto Rico) were deleted from the dataset.

Then, an analysis of duplicate records by open or close status further isolated MCRC unit locations relating to this study. If the ISOPEN field equaled "Y," and if two or more records contained the same value for the organization ID, the geographical location (ZIP_CODE), and the effective date, we retained only one observation for further analysis. If two or more observations contained the same organizational ID and geographical location, but a different effective date, we retained the observation with the oldest effective date to capture only one MCRC unit per ZIP code and a longer open time span. If the ISOPEN field equaled "N," and two or more observations contained the same organizational ID and geographical location, but a different effective date, we retained the record with the most current effective date to capture a wider open time span.

Next, we created MCRC unit location files (Microsoft Excel format) for each annual cohort from CY 2000 to CY 2014 to scrub the applicable (open) MCRC unit

locations for each year. Within each MCRC unit location cohort file, if the ISOPEN field contained an "N" and the EFFECTIVE_DATE was before January 1 for the year of interest (e.g., January 1, 2000, for the 2000 cohort), the observation was deleted. In addition, if the ISOPEN field contained a "Y" and the EFFECTIVE_DATE was after December 31 for the year of interest (e.g. December 31, 2010, for the 2010 cohort), then the observation was deleted. Lastly, if the ISOPEN field contained an "N" and the EFFECTIVE_DATE field was blank, the observation was deleted, because there is no way of knowing if the location was open or closed during a particular year. Table 6 shows the final scrubbing results for each MCRC location cohort file.

Table 6. Results from Cleaning MCRC Locations Cohort Files.

| Cohort | Number of MCRC Locations |
|---|---|
| 2000 | 707 |
| 2001 | 833 |
| 2002 | 891 |
| 2003 | 906 |
| 2004 | 925 |
| 2005 | 942 |
| 2006 | 968 |
| 2007 | 1,022 |
| 2008 | 1,030 |
| 2009 | 1,036 |
| 2010 | 1,036 |
| 2011 | 1,043 |
| 2012 | 1,049 |
| 2013 | 1,055 |
| 2014 | 1,060 |

## B. POOLED CROSS-SECTIONAL DATA

The final pooled cross-sectional data merged MCRC unit location data with Marine Corps installation, detachment, and independent duty location data. A database of active duty locations other than MCRC units (i.e., installations, detachments, and independent duty stations) was created to capture potential passive means of recruiting enlisted personnel. The next two sub-sections explain the process for generating the datasets for Marine Corps installation and detachment locations, and the independent duty locations.

## 1. Data Sources

### *a. Marine Corps Installations Command*

The creation of an installation locations dataset relied on information available on the Marine Corps Installations Command website (http://www.mcicom.marines.mil/). We utilized information contained within this website to identify all Marine Corps installation locations. The results of this research (30 observations) were recorded in a Microsoft Excel spreadsheet for later inclusion in a merged locations dataset that includes all active duty Marine Corps locations. This spreadsheet does not include installations located OCONUS due to the scope of this research. Furthermore, the creation of this dataset does account for the effects of Base Closure and Realignment Commission (BRAC) decisions. Thus, this data assumes all of the installations existed during the period of interest (CY00 to CY14) for this study.

### *b. Marine Corps Training and Education Command*

The development of the detachment locations dataset relied on information available on the Marine Corps Training and Education Command website (http://www.tecom.marines.mil/). We utilized information from the units tab of this website to identify Marine Corps detachment locations within the CONUS. The results of this research (21 observations) were placed into the Marine Corps installations spreadsheet to make one dataset of all Marine Corps installations and detachments. An underlying assumption in the creation of this dataset is that all of these detachments exist throughout the period of interest for this study, and the locations do not account for the effects of BRAC decisions.

### *c. Marine Forces Reserves*

The final dataset includes location data of all the independent duty stations falling under the cognizance of Marine Forces Reserves (MARFORRES). The creation of this dataset relied on information provided by the unit directory that is available on the MARFORRES website (http://www.marforres.marines.mil/). The results of this research (163 observations) got placed in a MARFORRES (independent duty) locations

spreadsheet to facilitate inclusion in other datasets for this study. Similar to the installation and detachment location datasets described above, the independent duty stations dataset assumes that all locations exist during the period of interest for this study, and these locations do not represent the effects of BRAC decisions.

## 2. Data Cleaning

### *a. Variables*

When creating the installations, detachments, and independent duty location datasets mentioned above, the same variables for each dataset were also created. The seven variables include: UNIT_NAME, ORG_TYPE, STREET, STREET 2, CITY, STATE_CODE, and ZIP_CODE. The author chose these variables because they mimic the geographic variables contained within the MCRC unit location dataset, and therefore allow for a simple merge of all active duty Marine Corps locations into a single dataset.

### *b. Data Cleaning and Merging*

Prior to merging all of the aforementioned files into a single Marine Corps locations dataset, each file got scrubbed to ensure the datasets capture only one unit per ZIP code. This study retains only one unit per ZIP code for geocoding purposes. If two or more units fall within the same ZIP code and these units are included in the GIS model, then enlisted accession observations get duplicated with each additional unit per ZIP code. Therefore, we scrubbed duplicate ZIP codes in each of the Marine Corps location files. If two or more units existed per ZIP code, the excess units got removed from the dataset. Upon cleaning the installations, detachments, and independent duty location datasets, all of the location datasets, including the MCRC unit locations dataset, were merged into a single file.

The result of merging all of the location datasets is one file that contains all active duty Marine Corps locations, including active (MCRC locations) and passive (installation, detachment and independent duty locations) measures for accessing enlisted personnel. The merged file was also scrubbed to ensure multiple units per ZIP code did not exist. This data cleaning procedure identified ZIP codes that contained two or more

unit types from each of the independent datasets (e.g., ZIP code contains a MCRC unit, installation, detachment, and/or independent duty station). All of the excess units got deleted and only one active duty unit location is kept per ZIP code. Table 7 displays the total number of active duty location observations before and after cleaning the data The resulting location observations serve as the active duty location inputs for this study's GIS model.

Table 7. Results from Cleaning Merged Active Duty Location Cohort Files.

| Cohort | Active Duty Locations before Cleaning | Active Duty Location for GIS Model |
|---|---|---|
| 2000 | 908 | 875 |
| 2001 | 1,034 | 1,003 |
| 2002 | 1,092 | 1,061 |
| 2003 | 1,107 | 1,076 |
| 2004 | 1,126 | 1,095 |
| 2005 | 1,143 | 1,112 |
| 2006 | 1,169 | 1,138 |
| 2007 | 1,223 | 1,190 |
| 2008 | 1,231 | 1,198 |
| 2009 | 1,237 | 1,204 |
| 2010 | 1,237 | 1,204 |
| 2011 | 1,244 | 1,211 |
| 2012 | 1,250 | 1,217 |
| 2013 | 1,256 | 1,223 |
| 2014 | 1,261 | 1,228 |

## C. PREPARING AND MODELING THE DATA

The nature of this study requires data from the enlisted accession, active duty locations, and MCRC unit locations datasets to serve as inputs for the GIS model. The research then models these data within the GIS to produce outputs that serve as geospatial variable inputs in the multivariate regression models. For the rest of this study, we refer to the merged active duty locations dataset as active duty locations and the MCRC unit locations only dataset as MCRC locations.

### 1. Preparing Data for GIS Model

This study utilizes MapInfo Professional (version 15.2.4) to develop the GIS models for each enlisted accession cohort. The first step in preparing the data for the GIS model involves some file management tasks necessary to ensure the downloaded ZCTA files get imported into MapInfo properly. All of the ZCTA .shp files use latitude/longitude as the projection and NAD-83 as the datum. The projection and datum details become important when creating .tab files. Once each ZCTA is saved in the .tab format, these files become the working files used to geocode enlisted accession and active duty location data.

The last step to prepare the data for the GIS model is geocoding. Geocoding is the process of assigning tabular data (i.e., individual enlisted accessions or active duty units) a set of X and Y coordinates (like latitude/longitude), facilitating the geospatial projection of each observation within the datasets. Some methods of geocoding include the use of a geocode server (e.g., MapMarker), using a geocoder built into the GIS, or using a geospatial dataset as a reference for geocoding. In this study, the USCB ZCTA datasets serve as the georeference for all geocoding.

The geocoding process involves matching the home of record ZIP code variable from the enlisted accession cohorts, and the ZIP code variable from the active duty and MCRC cohorts, to the Zcta5ceyy variable of each respective ZCTA dataset. This study uses interactive geocoding, which allows the GIS user to select an appropriate ZIP code if a match does not exist within the georeference dataset. If an observation's ZIP code did not match any of the ZIP codes in the georeference dataset, we queried the USPS address database (https://tools.usps.com/go/ZipLookupAction!input.action) using the city and state to get a best-fit ZIP code. For example, nearly every military base uses a PO Box, so the nearest/adjacent ZIP code was selected to facilitate geocoding of military installations. See Appendix C for the detailed geocoding procedures used in this study. Table 8 displays the geocoding results for the enlisted accession cohorts and Table 9 shows the geocoding results for the active duty locations cohorts.

Table 8. Geocoding Results for Enlisted Accessions by Cohort.

| Cohort | Geocoded | Not Geocoded | Total | % Geocoded | % Retained |
|---|---|---|---|---|---|
| 2000 | 28,435 | 598 | 29,033 | 97.94% | 96.71% |
| 2001 | 29,302 | 727 | 30,029 | 97.58% | 96.42% |
| 2002 | 30,034 | 1,046 | 31,080 | 96.63% | 95.77% |
| 2003 | 30,328 | 945 | 31,273 | 96.98% | 95.99% |
| 2004 | 29,477 | 961 | 30,438 | 96.84% | 95.83% |
| 2005 | 30,406 | 992 | 31,398 | 96.84% | 95.86% |
| 2006 | 30,224 | 1,103 | 31,327 | 96.48% | 95.39% |
| 2007 | 33,490 | 1,337 | 34,827 | 96.16% | 95.07% |
| 2008 | 36,065 | 1,315 | 37,380 | 96.48% | 95.40% |
| 2009 | 28,670 | 1,035 | 29,705 | 96.52% | 92.23% |
| 2010 | 24,279 | 343 | 24,622 | 98.61% | 89.52% |
| 2011 | 25,863 | 340 | 26,203 | 98.70% | 88.13% |
| 2012 | 28,364 | 287 | 28,651 | 99.00% | 90.81% |
| 2013 | 30,490 | 279 | 30,769 | 99.09% | 96.51% |
| 2014 | 25,440 | 224 | 25,664 | 99.13% | 97.71% |
| Totals | 440,867 | 11,532 | 452,399 | 97.45% | 94.53% |

Table 9. Geocoding Results for Active Duty Locations by Cohort.

| Cohort | Geocoded | Not Geocoded | Total | % Geocoded | % Retained |
|---|---|---|---|---|---|
| 2000 | 874 | 1 | 875 | 99.89% | 96.26% |
| 2001 | 1,001 | 2 | 1,003 | 99.80% | 96.90% |
| 2002 | 1,059 | 2 | 1,061 | 99.81% | 96.98% |
| 2003 | 1,074 | 2 | 1,076 | 99.81% | 97.02% |
| 2004 | 1,092 | 3 | 1,095 | 99.73% | 96.98% |
| 2005 | 1,109 | 3 | 1,112 | 99.73% | 97.03% |
| 2006 | 1,135 | 3 | 1,138 | 99.74% | 97.09% |
| 2007 | 1,187 | 3 | 1,190 | 99.75% | 97.06% |
| 2008 | 1,196 | 2 | 1,198 | 99.83% | 97.16% |
| 2009 | 1,202 | 2 | 1,204 | 99.83% | 97.17% |
| 2010 | 1,202 | 2 | 1,204 | 99.83% | 97.17% |
| 2011 | 1,209 | 2 | 1,211 | 99.83% | 97.19% |
| 2012 | 1,215 | 2 | 1,217 | 99.84% | 97.20% |
| 2013 | 1,221 | 2 | 1,223 | 99.84% | 97.21% |
| 2014 | 1,226 | 2 | 1,228 | 99.84% | 97.22% |

## 2. Modeling the Data in the GIS

Once the data are geocoded, we generated GIS models for each enlisted accession cohort to identify individual to calculate every individual enlistee's distance in relation to any active duty Marine Corps location. The model required the development of radius rings using the cosmetic layer in MapInfo to identify the individuals that fell within an

active duty location's distance radius. This study creates 10, 25, 50, and 100-mile radius rings around the centroid of each active duty location to classify enlisted accession distances from an active duty location. Appendix D provides detailed steps on how the researchers developed the GIS model that classifies distances for each enlisted accession from CY 2000 through CY 2014. Figure 7 shows the radius rings created around each active duty location for the CY 2000 geospatial analysis. Figure 8 displays a close-up view of an individual active duty location.

Figure 7. Radius Rings for Cohort 2000 GIS Model.

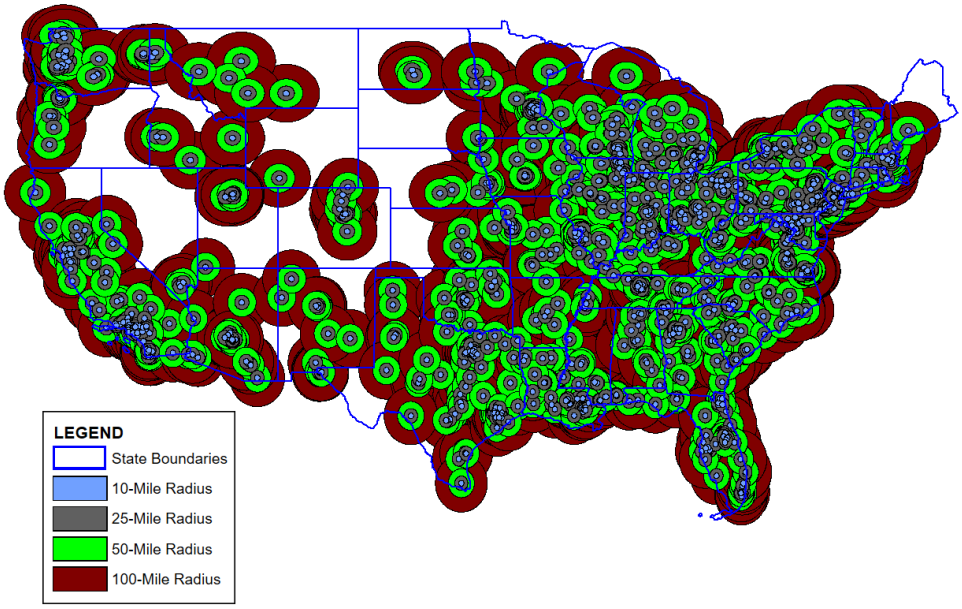
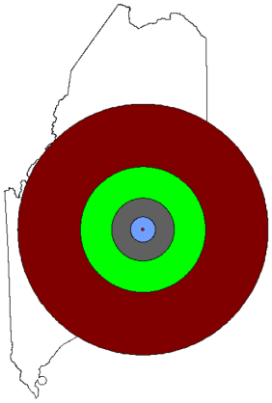



Figure 8. Zoom View for Radius Rings Around One Active Duty Location.



`

The study also generates GIS models for each enlisted accession cohort to identify individual distance data in relation to MCRC unit locations only. Within these MCRC location models, all Marine Corps installations, detachments, and independent duty stations are excluded in distance calculations. The development of the models that include only MCRC unit locations use the same modeling procedures explained in Appendix D. The intent for developing the GIS models using MCRC units only is to determine the variability between active and passive recruiting efforts.

### 3. Multivariate Regression Model

This research uses two multivariate regression methods. First, a multivariate linear regression (MLR) model was developed to estimate the effects of distance on high quality enlisted accessions as measured by performance on the AFQT. Then, we used a logistic (logit) regression model to determine the probability of accessing exceptionally high quality enlisted personnel. An exceptionally high quality accession is defined as an individual enlistee who scored above the 85th percentile on the AFQT. In addition to the variables provided in the enlisted accession datasets, such as demographic characteristics, the regression models use the geospatial outputs (i.e., an enlisted accession's distance from a Marine Corps location) from the GIS models to serve as variables. Six multivariate regression models are estimated and analyzed, as described in the subsequent Sections of this Chapter.

The enlisted accession datasets also require additional data cleaning and coding, prior to the estimating the multivariate regression models. First, we created indicator variables capturing the individuals distance from an active duty location. Specifically, we constructed *cdist_10, cdist_1125*, *cdist_2650, cdist_51100* and *cdist_100*. These are all indicator variables equal to 1 if the individual accessing is within that radius distance, and 0 otherwise. For example, *cdist_10* equals 1 if that individual's home of record is between zero and 10 miles of an active duty location. The *cdist_1125*, *cdist_2650*, and *cdist_51100* variables identify enlisted accessions falling between 11 and 25 miles, 26 and 50 miles, and 51 and 100 miles, respectively, of an active duty location. The *cdist_100* variable captures everyone falling outside of a 100-mile radius.

`

Other independent variables include standard demographic controls. We created indicator variables for gender (*female*), race (*black*), education (*hs_dipl*) and marital status (*acc_nevmar*). For instance, the *female* variable equals 1 if the individual accession is a female, but 0 if the accession is male. The *black* variable equals 1 if an accession is African American and 0 otherwise, and the *hs_dipl* variables equals 1 if an individual is a high school graduate, 0 otherwise. Lastly, the *acc_nevmar* variable equals 1 if an accession is single, but 0 if married or divorced.

### *a. Modeling the Data for Regressions*

This study estimates two sets of regressions. First, we estimate two MLR models and one logit regression model controlling for distance with respect to all active duty USMC locations. Then, we estimate two MLR models and one logit regression controlling for distance with respect to MCRC units (active recruiting locations) only.

The first MLR model in Equation (1) estimates the effect of distance from active duty locations on high quality enlisted accessions. Then, we use this same MLR model to estimate the effect of distance from MCRC locations on high quality enlisted accessions to identify differences in active and passive recruiting processes.

$$afqt_i = \beta_0 + \beta_1 d_{female} + \beta_2 d_{black} + \beta_3 d_{acc\_nevmar} + \beta_4^{acc\_age} + \beta_5 d_{hs\_dipl} + \beta_6 d_{cdist\_10} + \beta_7 d_{cdist\_1125} + \beta_8 d_{cdist\_2650} + \beta_9 d_{cdist\_51100} + \varepsilon_i \quad (1)$$

In this model, $i$ indexes the individual and the control variables as described above. In terms of location, $\beta_6, \beta_7, \beta_8, \beta_9$ estimate the effect of being 0–10, 11–25, 26–50, and 51–100 miles, respectively, relative to being 100+ miles (the baseline category), on high quality accessions as measured by the AFQT.

The second MLR model in Equation (2) uses interaction terms to test for differential effects of distance from an active duty location by gender, race and education (hs_dipl). The same MLR model is then used to account for differential effects of distance from a MCRC location by female, black, and education.

$$
\begin{aligned}
afqt_i = {} & \beta_0 + \beta_1 d_{female} + \beta_2 d_{black} + \beta_3 d_{acc\_nevmar} + \beta_4^{acc\_age} + \\
& \beta_5 d_{hs\_dipl} + \beta_6 d_{cdist\_10} + \beta_7 d_{cdist\_1125} + \beta_8 d_{cdist\_2650} + \beta_9 d_{cdist\_51100} + \\
& \beta_{10} d_{female*cdist\_10} + \beta_{11} d_{female*cdist\_1125} + \beta_{12} d_{female*cdist\_2650} + \\
& \beta_{13} d_{female*cdist\_51100} + \beta_{14} d_{black*cdist\_10} + \beta_{15} d_{black*cdist\_1125} + \\
& \beta_{16} d_{black*cdist\_2650} + \beta_{17} d_{black*cdist\_51100} + \beta_{18} d_{hs\_dipl*cdist\_10} + \\
& \beta_{19} d_{hs\_dipl*cdist\_1125} + \beta_{20} d_{hs\_dipl*cdist\_2650} + \beta_{21} d_{hs\_dipl*cdist\_51100} + \\
& \varepsilon_i
\end{aligned}
\tag{2}
$$

Third, a logit regression model (shown in Equation 3) estimates the probability of accessing exceptionally high quality enlistees by distance to an active duty station. To determine differences in active and passive recruiting efforts, this logit model is also used to estimate the probability of accessing exceptionally high quality enlisted personnel by distance to MCRC stations only.

$$
\begin{aligned}
hi\_afqt_i = {} & \beta_0 + \beta_1 d_{female} + \beta_2 d_{black} + \beta_3 d_{acc\_nevmar} + \beta_4^{acc\_age} + \\
& \beta_5 d_{hs\_dipl} + \beta_6 d_{cdist\_10} + \beta_7 d_{cdist\_1125} + \beta_8 d_{cdist\_2650} + \beta_9 d_{cdist\_51100} + \varepsilon_i
\end{aligned}
\tag{3}
$$

### *b. Summary Statistics*

This study relies on the two enlisted accession datasets described in this Chapter for the analysis. The first dataset includes all of the enlisted accession data, including the distance variables generated by the GIS model using the pooled cross-sectional data for all active duty and MCRC locations. The summary statistics for the enlisted accessions included in the active duty location models and MCRC location models are displayed in Tables 10 and 11, respectively.

Women account for nearly 8% of Marine Corps enlisted accessions between 2000 and 2014. During this same period, less than 10% of the enlisted accession population was African American, while whites comprise an overwhelming majority of enlisted accessions (80.6%). Moreover, almost all enlistees are never married (97.4%), and most have a high school diploma (92.1%) at the time of accession. The *cdist_51100* variable indicates that nearly 60% of enlistees have a home of record between 51 and 100 miles from an active duty location or MCRC location.

`

Table 10. Summary Statistics for Active Duty Locations Model.

| Variables | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|
| AFQT | 60.69 | 18.28 | 1 | 99 |
| hi_afqt | 1.07% | 0.309 | 0 | 1 |
| acc_age | 19.31 | 2.039 | 17 | 44 |
| female | 7.7% | 0.267 | 0 | 1 |
| male | 92.3% | 0.267 | 0 | 1 |
| black | 9.46% | 0.293 | 0 | 1 |
| white | 80.6% | 0.395 | 0 | 1 |
| asian | 2.52% | 0.157 | 0 | 1 |
| hs_dipl | 92.1% | 0.270 | 0 | 1 |
| acc_nevmar | 97.4% | 0.160 | 0 | 1 |
| cdist_10 | 3.53% | 0.184 | 0 | 1 |
| cdist_1125 | 10.7% | 0.309 | 0 | 1 |
| cdist_2650 | 22.9% | 0.420 | 0 | 1 |
| cdist_51100 | 59.7% | 0.490 | 0 | 1 |
| cdist_100 | 3.12% | 0.174 | 0 | 1 |
| Number of Observations (n) = 448,018 | | | | |

Table 11. Summary Statistics for MCRC Locations Model.

| Variables | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|
| AFQT | 60.69 | 18.28 | 1 | 99 |
| hi_afqt | 1.07% | 0.309 | 0 | 1 |
| acc_age | 19.31 | 2.039 | 17 | 44 |
| female | 7.7% | 0.267 | 0 | 1 |
| male | 92.3% | 0.267 | 0 | 1 |
| black | 9.46% | 0.293 | 0 | 1 |
| white | 80.6% | 0.395 | 0 | 1 |
| asian | 2.52% | 0.157 | 0 | 1 |
| hs_dipl | 92.1% | 0.270 | 0 | 1 |
| acc_nevmar | 97.4% | 0.160 | 0 | 1 |
| cdist_10 | 3.49% | 0.184 | 0 | 1 |
| cdist_1125 | 10.6% | 0.308 | 0 | 1 |
| cdist_2650 | 22.8% | 0.420 | 0 | 1 |
| cdist_51100 | 59.9% | 0.490 | 0 | 1 |
| cdist_100 | 3.18% | 0.175 | 0 | 1 |
| Number of Observations (n) = 448,018 | | | | |

Naturally, both models utilize the same number of observations; the differences are in the summary statistics for the *cdist* variables. Interestingly, it appears that very little variation exists between the distance variables in the two models. One can reasonably assume that this is because all of the enlisted accessions get captured in both

the active duty locations GIS model and the MCRC locations GIS model. Thus, it initially seems that passive measures (i.e., active duty presence at installations, detachments, and independent duty stations) vs. active recruiting stations may have no differential effect on accessing high quality enlisted personnel.

THIS PAGE INTENTIONALLY LEFT BLANK

# V. RESULTS AND ANALYSIS

## A. GIS MODELS

This study generates two GIS models to identify geospatial variables for individual accessions in relation to active duty locations and MCRC locations only. Using the geocoded enlisted accession results, such as the example shown in Figure 9, we first identify for each individual enlistee whether their home of record at enlist falls within a 10, 25, 50, 100, or over 100-mile radius of a Marine Corps location. These indicators provide geospatial variables that we include as independent variables in multivariate regression analyses. The maps shown in Figures 10 and 11 illustrate the geospatial distribution of enlisted accessions falling within, or outside of, each radius ring for an individual cohort in the active duty locations model and the MCRC locations model, respectively.

Figure 9. Geocoding Results for CY 2000 Enlisted Accessions.

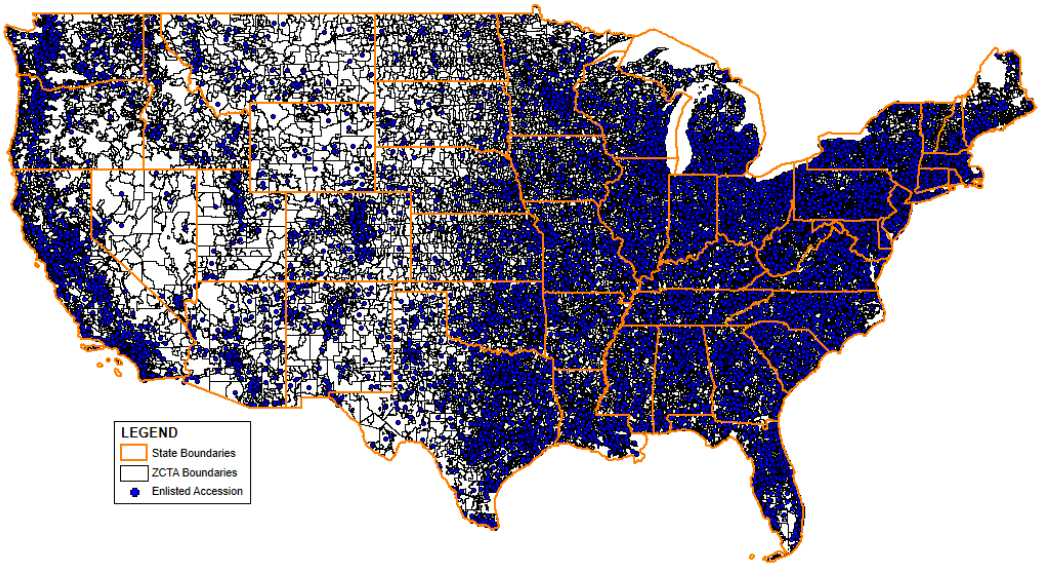


Figure 10. Accessions in Active Duty Locations GIS Model for CY 2014.

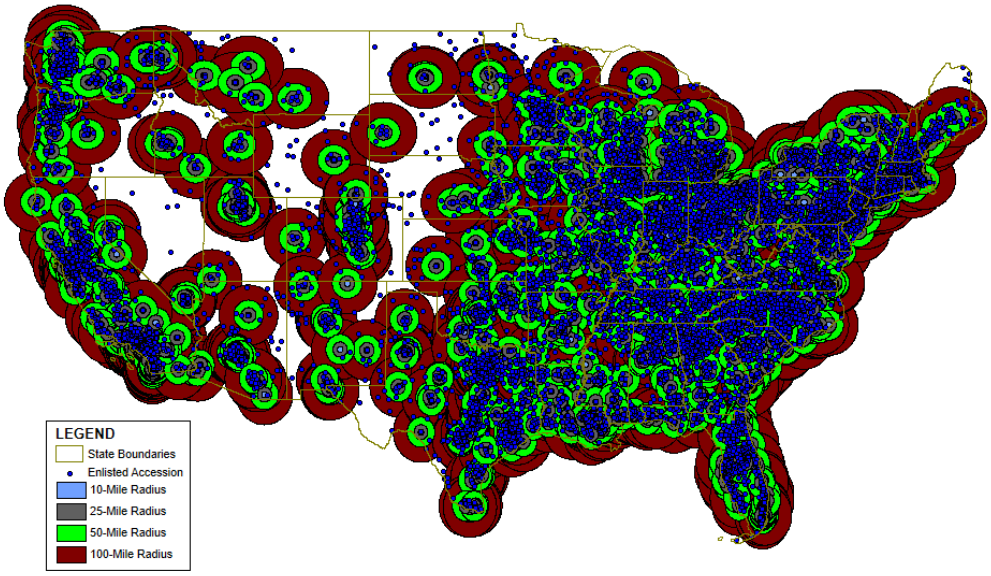
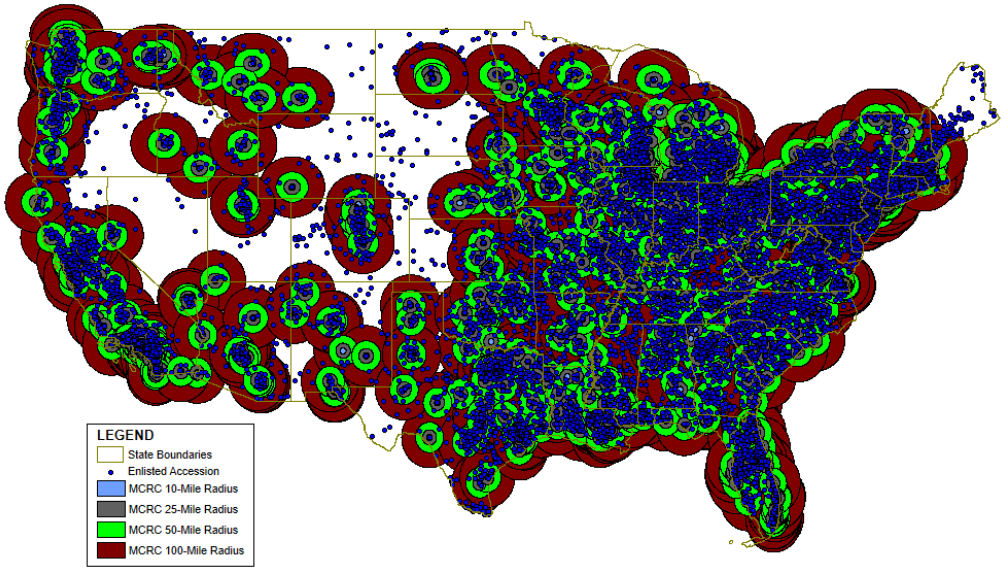



Figure 11. Accessions in MCRC Locations GIS Model for CY 2000.




Both of the GIS models indicate that a large majority (82.68% in the active duty locations model and 82.71% in the MCRC locations model) of enlisted accessions are geographically distributed between 26 and 100 miles in relation to any active duty Marine Corps installation, detachment, recruiting unit, or independent duty station.

`

Interestingly, this trend varies by only +/- 1%, on average, for each annual cohort in both of the GIS models for the entire enlisted accession observation period. From a visual perspective, it appears that the preponderance of enlisted accessions exist within the eastern portion of the U.S. Although densely populated areas—such as urban centers that contain the recruiting facilities—seemingly provide a larger proportion of enlisted accessions, the GIS models suggest that the high quality individuals choosing to join the Marine Corps typically reside throughout the rural regions of the U.S. The results for each CY and the cumulative effects of both GIS models are shown in Tables 12 and 13.

Table 12. Results from Active Duty Locations GIS Model by CY.

| CY | cdist_10 | cdist_1125 | cdist_2650 | cdist_51100 | cdist_100 | Total |
|---|---|---|---|---|---|---|
| 2000 | 1,027 | 3,027 | 6,461 | 17,537 | 955 | 29,007 |
| 2001 | 1,092 | 3,140 | 6,702 | 17,876 | 928 | 29,738 |
| 2002 | 1,135 | 3,267 | 6,764 | 17,710 | 1,158 | 30,034 |
| 2003 | 1,164 | 3,374 | 6,971 | 18,276 | 1,087 | 30,872 |
| 2004 | 1,081 | 3,211 | 6,828 | 17,703 | 1,097 | 29,920 |
| 2005 | 1,078 | 3,347 | 7,177 | 18,407 | 1,140 | 31,149 |
| 2006 | 1,076 | 3,280 | 6,847 | 18,334 | 1,266 | 30,803 |
| 2007 | 1,170 | 3,546 | 7,744 | 20,542 | 1,482 | 34,484 |
| 2008 | 1,277 | 3,809 | 8,577 | 22,010 | 1,510 | 37,183 |
| 2009 | 987 | 3,167 | 6,670 | 17,613 | 1,186 | 29,623 |
| 2010 | 885 | 2,610 | 5,819 | 14,790 | 504 | 24,608 |
| 2011 | 867 | 2,828 | 6,117 | 15,897 | 487 | 26,196 |
| 2012 | 965 | 3,072 | 6,648 | 16,923 | 405 | 28,013 |
| 2013 | 1,086 | 3,315 | 7,237 | 18,682 | 414 | 30,734 |
| 2014 | 910 | 2,817 | 6,169 | 15,389 | 369 | 25,654 |
| Totals | 15,800 (3.53%) | 47,810 (10.67%) | 102,731 (22.93%) | 267,689 (59.75%) | 13,988 (3.12%) | 448,018 (100.00%) |

Table 13. Results from MCRC Locations GIS Model by CY.

| CY | cdist_10 | cdist_1125 | cdist_2650 | cdist_51100 | cdist_100 | Total |
|---|---|---|---|---|---|---|
| 2000 | 985 | 2,848 | 6,175 | 17,948 | 1,051 | 29,007 |
| 2001 | 1,031 | 3,033 | 6,748 | 17,984 | 942 | 29,738 |
| 2002 | 1,140 | 3,164 | 6,855 | 17,705 | 1,170 | 30,034 |
| 2003 | 1,090 | 3,290 | 6,996 | 18,396 | 1,100 | 30,872 |
| 2004 | 1,021 | 3,210 | 6,918 | 17,656 | 1,115 | 29,920 |
| 2005 | 1,114 | 3,320 | 7,093 | 18,471 | 1,151 | 31,149 |
| 2006 | 1,098 | 3,312 | 6,883 | 18,238 | 1,272 | 30,803 |
| 2007 | 1,186 | 3,587 | 7,681 | 20,536 | 1,494 | 34,484 |
| 2008 | 1,252 | 3,831 | 8,451 | 22,130 | 1,519 | 37,183 |
| 2009 | 1,032 | 3,107 | 6,636 | 17,654 | 1,194 | 29,623 |
| 2010 | 871 | 2,742 | 5,729 | 14,753 | 513 | 24,608 |
| 2011 | 861 | 2,962 | 6,163 | 15,710 | 500 | 26,196 |
| 2012 | 967 | 2,976 | 6,621 | 17,026 | 423 | 28,013 |
| 2013 | 1,083 | 3,347 | 7,267 | 18,609 | 428 | 30,734 |
| 2014 | 924 | 2,869 | 6,091 | 15,391 | 379 | 25,654 |
| Totals | 15,655 (3.49%) | 47,598 (10.62%) | 102,307 (22.84%) | 268,207 (59.87%) | 14,251 (3.18%) | 448,018 (100.00%) |

`

## B. MULTIVARIATE REGRESSION MODELS

The results suggest that gender, race, age, civilian education, marital status, and distance from an active duty location contribute to the accession of high quality enlisted personnel in the Marine Corps. The active duty locations model shows that females typically score about 1.29 points lesson, on average, than males holding all other factors constant. Blacks also tend to perform more poorly on the AFQT when compared to all other races, on average, and high quality enlisted accessions increase as age increases. A Marine accession that has never been married typically does better on the AFQT than those that are married, while enlistees with a high school diploma typically score about 2.5 points less on their AFQT, on average.

Although more individuals join from further distances from active duty Marine Corps locations, the quality of personnel typically declines as distance increases, except for enlisted accessions located beyond the 100-mile radius. In fact, individuals located outside 100 miles do better on the AFQT, on average, indicating that enlisted accessions existing within rural areas contain the attributes sought in high quality enlisted personnel.

When we look at the differences between the MLR model containing MCRC locations only (Table 14), versus the MLR model encompassing all active duty Marine Corps locations, the betas do not vary much. However, the results show that passive recruiting efforts (i.e., the presence of active duty Marines stationed at installations, detachments, or independent duty locations) indeed affect the quality of enlisted accessions. While holding all other factors constant, an enlisted accession residing within 10-miles of any active duty location in the active duty locations model scores 0.13 points higher on the AFQT than individuals within 10-miles in the MCRC locations model, on average. Moreover, if an individual lives between 11 and 25 miles from any active duty location in the active duty locations model, an accession scores 0.1 points higher on the AFQT than an individual living within the 11 to 25 mile range in the MCRC locations model. Both models suggest that accessions procured outside of the 50-mile radius score lower on the AFQT, on average.

Table 14. Results for High Quality Accessions in MLR Models.

| Variables | Active Duty Locations | MCRC Locations |
|---|---|---|
| female | -1.2882*** | -1.2875*** |
| | [0.0962] | [0.0962] |
| black | -8.9259*** | -8.9201*** |
| | [0.0854] | [0.0853] |
| acc_age | 0.7279*** | 0.7284*** |
| | [0.0146] | [0.0146] |
| acc_nevmar | 1.9584*** | 1.9526*** |
| | [0.1790] | [0.1791] |
| hs_dipl | -2.5071*** | -2.5087*** |
| | [0.1007] | [0.1007] |
| cdist_10 | 0.2570 | 0.1272 |
| | [0.2118] | [0.2109] |
| cdist_1125 | 0.2979* | 0.1944 |
| | [0.1764] | [0.1752] |
| cdist_2650 | -0.0199 | -0.0041 |
| | [0.1657] | [0.1643] |
| cdist_51100 | -0.3069* | -0.2612* |
| | [0.1597] | [0.1582] |
| Constant | 45.9422*** | 45.9284*** |
| | [0.4281] | [0.4273] |
| $R^2$ | 0.035 | 0.035 |
| Adjusted $R^2$ | 0.0352 | 0.0351 |
| Observations (n = 448,018) | | |
| Robust standard errors in brackets | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

This study finds variance among each of the interaction terms accounting for differential selection as shown in Table 15. Female enlistees having a home of record between 0 and 100 miles in relation to an active duty location score lower on the AFQT compared to females coming from outside a 100-mile distance. African Americans with a home of record between 0 and 10 miles from an active duty location perform worse on the AFQT, on average, compared to African Americans residing beyond a 100-mile distance; however, African Americans accessed between 11 and 100 miles before better compared to African Americans from outside 100 miles.

Moreover, high school graduates that live between 0 and 25 miles from an active duty location score higher on the AFQT compared to enlistees joining from distances 100 miles or greater from an active duty location. High school graduate enlistees with a home of record between 26 and 100 miles, however, typically perform worse on the AFQT compared to enlisted accessions procured beyond 100 miles from an active duty location. Interestingly, the MCRC locations MLR interaction model varies from the active-duty

locations MLR interaction model, suggesting high school graduates living within a distance of 0 to 25 and 51 to 100 from a MCRC location do not perform as well on the AFQT compared to enlistees from over 100 miles away from MCRC locations. The MCRC interaction model also suggests that the home of record for the highest quality high school graduates exists between 26 and 50 miles from a MCRC location.

Table 15. Results for High Quality Accessions in MLR Interaction Models.

| Variables | Active Duty Locations | MCRC Locations |
|---|---|---|
| female | -0.1719 | -0.1393 |
| | [0.5570] | [0.5520] |
| black | -9.3922*** | -9.3036*** |
| | [0.5597] | [0.5593] |
| acc_age | 0.7279*** | 0.7285*** |
| | [0.0146] | [0.0146] |
| acc_nevmar | 1.9588*** | 1.9551*** |
| | [0.1790] | [0.1790] |
| hs_dipl | -2.3359*** | -2.3883*** |
| | [0.5651] | [0.5589] |
| cdist_10 | 0.2261 | 0.4632 |
| | [0.7333] | [0.7222] |
| cdist_1125 | 0.2277 | 0.3396 |
| | [0.6147] | [0.6111] |
| cdist_2650 | 0.0970 | -0.1100 |
| | [0.5787] | [0.5737] |
| cdist_51100 | 0.0148 | 0.0147 |
| | [0.5574] | [0.5515] |
| cdist_10Xfemale | -0.7350 | -1.6164** |
| | [0.7525] | [0.7478] |
| cdist_1125Xfemale | -1.3648** | -1.4775** |
| | [0.6296] | [0.6243] |
| cdist_2650Xfemale | -1.3368** | -1.1867** |
| | [0.5911] | [0.5864] |
| cdist_51100Xfemale | -1.0635* | -1.1019* |
| | [0.5708] | [0.5661] |
| cdist_10Xblack | -0.2178 | 0.5516 |
| | [0.6874] | [0.7039] |
| cdist_1125Xblack | 0.4647 | 1.2137** |
| | [0.6121] | [0.6140] |
| cdist_2650Xblack | 0.7908 | 0.4750 |
| | [0.5874] | [0.5858] |
| cdist_51100Xblack | 0.4112 | 0.1866 |
| | [0.5707] | [0.5703] |
| cdist_10Xhs_dipl | 0.1448 | -0.2849 |
| | [0.7618] | [0.7526] |
| cdist_1125Xhs_dipl | 0.1507 | -0.1620 |
| | [0.6391] | [0.6353] |
| cdist_2650Xhs_dipl | -0.0895 | 0.1699 |
| | [0.6016] | [0.5964] |
| cdist_51100Xhs_dipl | -0.2962 | -0.2223 |
| | [0.5796] | [0.5735] |
| Observations (n = 448,018) | | |
| Robust standard errors in brackets | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

The MLR interaction models also reveal a difference between active and passive recruiting. Again, variation in quality exists between the active duty locations model and the MCRC locations model. The interaction of female and distance variables reveals that geospatial proximity to active duty locations results in higher AFQT scores for females, except those located between 51 and 100-miles. The biggest difference between race and distance, however, indicates that high quality blacks exist over 50 miles in the active duty locations model and under 50 miles in the MCRC locations model. Education improves quality under 25 miles in the active duty locations model and over 25 miles in the MCRC locations model.

The probabilities of accessing exceptionally high quality personnel (scoring in the top 15th percentile on the AFQT) are shown in Table 16. Although the traditional accession variables, such as age, gender, race, and education confirm existing patterns, it is surprising how distance negatively affects the accession of exceptionally high quality enlisted personnel in both models. The results of both logit models suggest lower probabilities for accessing exceptionally high quality enlisted personnel if the enlistee's home of record is located between 0 and 100 miles from both active duty locations and MCRC locations when compared to accessions joining from beyond 100 miles.

Table 16. Results for Exceptionally High Quality Accessions in Logit Models.

| Variables | Active Duty Locations | MCRC Locations |
|---|---|---|
| female | -0.277*** | -0.277*** |
| | (0.0205) | (0.0205) |
| black | -1.137*** | -1.136*** |
| | (0.0254) | (0.0254) |
| acc_age | 0.137*** | 0.137*** |
| | (0.00212) | (0.00212) |
| acc_nevmar | 0.384*** | 0.384*** |
| | (0.0310) | (0.0310) |
| hs_dipl | -0.264*** | -0.264*** |
| | (0.0159) | (0.0159) |
| cdist_10 | -0.00386 | -0.0446 |
| | (0.0371) | (0.0372) |
| cdist_1125 | -0.00226 | -0.0116 |
| | (0.0306) | (0.0304) |
| cdist_2650 | -0.0537* | -0.0513* |
| | (0.0287) | (0.0285) |
| cdist_51100 | -0.0861*** | -0.0803*** |
| | (0.0276) | (0.0274) |
| Constant | -5.059*** | -5.061*** |
| | (0.0701) | (0.0700) |
| Observations (n = 448,018) | | |
| Robust standard errors in parentheses | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

`

## C. SUMMARY

This study confirms prior research results on females, African Americans, age, and marital status. On average, we find that enlisted accessions located between 26 and 100 miles from an active duty location perform worse on the AFQT compared to individual enlistees located beyond 100 miles from an active duty location. The enlisted accessions having a home of record between 0 and 25 miles from an active duty location, however, perform better on the AFQT compared to enlistees with a home of record that is beyond 100 miles from an active duty location.

The results for the differential effects of distance from active duty locations and MCRC locations, compared to accessions residing outside the 100-mile distance, provide interesting and new findings on high quality enlisted accessions. The active duty locations model suggests that the top quality female accessions come from areas located within a 10-mile radius of an active duty location. High quality African-Americans, however, fall within a 26 to 50 mile radius of an active duty location, while civilian education indicates that quality enlistees reside between 11 and 25 miles from an active duty location.

An analysis of the fluctuations to AFQT scores over the 15-year period in this study reveals interesting trends. Using CY 2000 as the base year, we notice the quality of enlisted accessions steadily rising from 2001 to 2003. Starting in 2004, however, quality accessions decline until 2007—a likely product of the buildup in military manpower to support the surge in Iraq. Then, from 2008 to 2012 the Marine Corps progressively increased the quality of enlisted personnel. The shift to higher quality accessions is likely a result of military downsizing and manpower policy changes to enlistment waiver criteria. In 2013, the Corps experiences a slight decline in quality accessions, but rises again in 2014. Appendix E contains the CY results for the active duty locations MLR model, MCRC locations MLR model, active duty locations MLR interactions model, and the MCRC locations MLR interactions model.

Overall, this research finds that distance in relation to both active duty locations and MCRC locations indeed affects high quality enlisted accessions in the Marine Corps.

While some of the individual point estimates of the distance indicators are statistically insignificant in some of the models, joint hypothesis tests for both the active duty locations model and MCRC locations model indicate distance matters. In both of the joint tests, we reject the null hypotheses; the p-value (0.00) in both cases is less than 0.05. That is, there is a statistically significant positive relationship between high quality accession and distance less than 100 miles, particularly for females.

THIS PAGE INTENTIONALLY LEFT BLANK

# VI. CONCLUSIONS AND RECOMMENDATIONS

## A. SUMMARY

The men and women filling the Marine Corps' enlisted ranks undoubtedly serve as the most valuable resource for mission success. Marines commonly receive challenging tasks—both on the battlefield and in garrison— that push the human will to the bounds of mental and physical limits. These challenges reinforce the 37th CMC's top priority: the procurement of high quality enlisted Marines to meet the nation's current and future manpower demands (Neller, 2016). In a society where economic conditions frequently fluctuate, recruiting efforts remain competitive among services, and cultural beliefs evolve, the Marine Corps must continue to seek innovative means to gain a comparative advantage with high quality enlisted accessions.

This study offers a new and interesting way of estimating the effect of high quality enlisted accession by incorporating geospatial analyses and multivariate regression analyses that account for distance variables in relation to active duty Marine Corps locations and MCRC locations. We find that distance does affect high quality enlistments from both an active duty locations perspective and a MCRC locations only standpoint. Moreover, we discover that passive recruiting efforts—via active duty presence at installations, detachments, and independent duty stations—accounts for some of the effect on high quality enlisted accessions.

## B. CONCLUSIONS

We conclude this study by revisiting the research questions introduced in Chapter I. First, we address the primary research question: What is the effect of an active duty Marine presence on selecting high quality enlisted accessions? The GIS models show that the home of record for over 82% of all enlisted accessions fall between 26 and 100 miles from an active duty location. Using the *cdist_100* variable (accessions located outside 100 miles) as the base year, the *cdist_10* and *cdist _1125* variables find a positive effect on high quality enlisted accessions for both the active duty locations MLR model and the MCRC locations MLR model. The *cdist_2650* and *cdist_51100* variables, however,

suggest a negative effect on high quality enlisted accessions in both MLR models relative to the omitted group of *cdist_100,* individuals residing over 100 miles away from either an active duty location or a MCRC location.

Next, we address the first of two secondary questions: Do other factors—such as age, race, gender, education, and marital status—affect high quality enlisted accessions? Although the traditional independent variables of age, gender, race, education, and marital status remain consistent with previous research when not considering measures of distance, this study finds mixed effects that depend on the distance an enlisted accession's home of record is in relation to an active duty location. Females, African Americans, and individuals that are married or divorced achieve lower scores on the AFQT, on average, compared to males, all other races, and single enlistees.

We also find that the differential selection of independent variables suggests mixed results. For instance, females with a home of record existing outside of a 100-mile radius typically perform better on the AFQT than females coming from under 100 miles in both the active duty locations and MCRC locations model. African Americans, however, appear to score better on the AFQT when residing within 100 miles of an active duty location, excluding the *cdist_10Xblack* variable in the active duty MLR model, which suggests a negative effect. Lastly, we find that high school graduates typically perform better on the AFQT if their home of record is within 25 miles, or beyond 100 miles, of an active duty location; whereas, the only positive effects for high school grads in relation to MCRC locations derive within a 26 to 50 mile range.

An analysis of exceptionally highly qualified enlisted accessions shows that younger, single individuals with a home of record existing beyond 100 miles from any active duty location, including MCRC locations, have a higher probability of scoring within the 15th percentile on the AFQT. On average, males, non-blacks, and non-high school graduates comprise the exceptionally high quality enlistees.

Lastly, we address the final secondary research question: does variation exist between active (recruiting) and passive (presence of non-recruiting Marine Corps personnel) methods for accessing high quality enlistees? We find that variation does exist

between the active duty locations model and the MCRC locations model, which serves as an indication that passive measures of recruiting (i.e., presence of active duty personnel located at installations, detachment, or independent duty stations) effect the accession of high quality enlisted personnel.

## C. RECOMMENDATIONS

### 1. Recommendations for Geospatial Analytics

The Marine Corps' total force structure process will continue to evolve as top leadership changes, technologies improve, and personnel requirements adjust to the demands of national defense. Therefore, we recommend leveraging GIS technologies in the development of manpower and recruiting models to account for geospatial attributes affiliated with future enlisted accessions.

### 2. Areas for Further Research

The limited availability of economic and survey data restrict the number of independent variables included in this study. For instance, if we include labor-market condition indicators as variables —such as unemployment rate, hiring rate, and the labor-force participation rate—at the ZIP code level, as well as survey data from the 2000–2014 enlisted accession population, we can estimate more robust statistical models.

Further research that involves geospatial and multivariate regression analyses should incorporate indicators for labor market conditions and survey data (i.e., propensity to join the Marine Corps, family income, parents' education, values and belief towards military service, and veteran status of parents) on a smaller temporal scale to account for more variation.

THIS PAGE INTENTIONALLY LEFT BLANK

# APPENDIX A. TO&E EXAMPLE

**Billet Organization**

M11131 - H&S CO 3/1 1ST MARDIV

| Rec CD | BIC | Billet Description | Alpha Grade | BMOS ASD1 ASD2 | PMOS | BRN | TYP | STA | MPR | Res Typ | SC | WPN | Billet SPN | CHARGEABLE | | | | | | | | NON-CHARGEABLE | | | | | | | | | | Mapped | | ASR | IH/CA | MCC | FTN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | Marine Active | | Marine Reserve | | Civ | Other Active | | Other Reserve | | Marine Active | | Marine Reserve | | Civ | | Other Active | | Other Reserve | | MT/MF | UIC | | | | |
| | | | | | | | | | | | | | | Off | Enl | Off | Enl | | Off | Enl | Off | Enl | Off | Enl | Off | Enl | NC | T/T | Off | Enl | Off | Enl | | | | | | |
| C | M1113100001 | BATTALION HEADQUARTERS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | M1113100002 | COMMANDING OFFICER | LTCOL | 0302 | 0302 | M | O | A | A | | T | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100003 | EXECUTIVE OFFICER | MAJ | 0302 | 0302 | M | O | A | A | | T | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100004 | SERGEANT MAJOR | SGTMAJ | 8999 | 8999 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M3300106486 | FAMILY READINESS OFFICER - 3/1 1ST MARDIV (M11131) | NF 4 | 1101 | 1101 | | | O | C | | U | U | | | | | | | | | | | | | | 1 | | | | | MF | M33001 | 0 | H-G06S | V31 | |
| E | M1113100005 | MESSENGER/DRIVER | PVT | 0311 | 0311 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100006 | MESSENGER/DRIVER | PVT | 0311 | 0311 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| Section Total | | C - BATTALION HEADQUARTERS | | | | | | | | | | | | 2 | 3 | | | | | | | | | | 1 | | | | | | | | | | |
| C | M1113100007 | ADMINISTRATIVE SECTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | M111310000E | ADJUTANT | 1STLT | 0102 | 0102 | M | O | A | A | | S | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M111310001C | ADMIN CHIEF | GYSGT | 0111 | 0111 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100023 | ADMIN CLERK | CPL | 0111 | 0111 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100025 | ADMIN CLERK | LCPL | 0111 | 0111 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100026 | ADMIN CLERK | LCPL | 0111 | 0111 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100029 | CMCC CLERK | LCPL | 0111 | 0111 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M111310003C | LEGAL ADMIN CLERK | LCPL | 0111 | 0111 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100033 | CAREER PLANNER | SSGT | 4821 | 4821 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| Section Total | | C - ADMINISTRATIVE SECTION | | | | | | | | | | | | 1 | 7 | | | | | | | | | | | | | | | | | | | | |
| C | M1113100034 | INTELLIGENCE SECTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | M1113100035 | INTELLIGENCE OFFICER | CAPT | 0202 | 0202 | M | O | A | A | | I | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100324 | ASSISTANT INTELLIGENCE OFFICER | 1STLT | 0203 | 0203 | M | O | A | A | | I | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100345 | INTELLIGENCE CHIEF | GYSGT | 0233 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100036 | ASSISTANT INTELLIGENCE CHIEF | SGT | 0231 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100032 | INTELLIGENCE SPECIALIST | SGT | 0231 | 0231 | M | E | A | A | | I | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100321 | INTELLIGENCE SPECIALIST | CPL | 0231 | 0231 | M | E | A | A | | I | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100322 | INTELLIGENCE SPECIALIST | LCPL | 0231 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100037 | INTELLIGENCE SPECIALIST | CPL | 0231 | 0231 | M | E | A | A | | I | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100038 | INTELLIGENCE SPECIALIST | LCPL | 0231 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100039 | INTELLIGENCE SPECIALIST | CPL | 0231 | 0231 | M | E | A | A | | I | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100323 | INTELLIGENCE SPECIALIST | PFC | 0231 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M111310004C | INTELLIGENCE SPECIALIST | LCPL | 0231 | 0231 | M | E | A | A | | I | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| D | M111310034E | SCOUT SNIPER PLATOON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | M1113100041 | SCOUT SNIPER PLATOON COMMANDER | 1STLT | 0203 | 0203 | M | O | A | A | | I | C | | 1 | | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100042 | SCOUT SNIPER PLATOON SERGEANT | SSGT | 0317 | 0369 | M | E | A | A | | U | C | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100043 | CHIEF SCOUT SNIPER | SGT | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100044 | SCOUT SNIPER | SGT | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100045 | SCOUT SNIPER | SGT | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100046 | SCOUT SNIPER | SGT | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100047 | SCOUT SNIPER | CPL | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100048 | SCOUT SNIPER | CPL | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |
| E | M1113100049 | SCOUT SNIPER | CPL | 0317 | 0311 | M | E | A | A | | U | M | | | 1 | | | | | | | | | | | | | | | | | 1 | A-M415 | V31 | |

Source: MCTFS (2016).

THIS PAGE INTENTIONALLY LEFT BLANK

# APPENDIX B. THREE-TIER SYSTEM FOR EDUCATION

| Tier | Category | Sub-Category | Criteria | Education Code |
|---|---|---|---|---|
| I | High School Graduate | Traditional/Religious High School Diploma | Possesses diploma | L |
| | | Traditional/Religious High School Senior | Transcript indicates evidence leading to diploma | S |
| | | Adult Education/Alternative Diploma | Earned secondary education diploma similar to traditional high school | B |
| | | Exit Exam Failure | Completion of all graduation requirements but did not pass exit exam | F |
| | | Completed One Semester of College | A non-high-school graduate (Tier II) completes a minimum of 15 semester /22 quarter credit hours of college work | 8 |
| | | Currently Enrolled in Other than High School Diploma | Presently enrolled and attending class in a Tier I category and will complete the program within 270 days (DEP only) | M |
| | | Home School Diploma Graduates (AFQT 50-99) | A high school diploma awarded by a local, state or nationally accredited Home School Association | H |
| | | Prior Service | Completed 3 or more years in active component and possesses General Education Development (GED) equivalency certificate, and adult high school diploma, or other credential equivalent of a high school diploma | 12L |
| II | Alternative Credential Holder | Home School Diploma Graduates (AFQT 21-49) | A high school diploma awarded by a local, state or nationally accredited Home School Association | H |
| | | National Guard Youth Program | Earned a GED while in the program. Only individuals that have completed the NGY program are eligible. | X |
| | | Test-Based Equivalency Diploma | An applicant who possesses a GED or other test-based equivalency certificate or diploma. | E |
| | | High School Certificate of Attendance/Completion of Special Education | MPPM high school verification letter with transcripts that reflects attendance through the 12th grade; or, a high school diploma/certificate based on and identified as Individualized Education Program (IEP) that involves community experience, employment, training, daily living skills and post-school transition skills which differ from the traditional high school requirements | J/L/B |
| | | Other Non-Traditional High School Credential | A secondary school credential issued for completing an alternative school/program that differs in course content and curriculum from traditional high school Diploma program (i.e. 12B or 12L). Schools or programs that are accelerated and issue a diploma based on combination of testing, independent study, adult based education (ABE) and/or competencies are classified as Tier II, regardless of whether the credential issued by a secondary or post-secondary institution. | 5 |
| | | Distance Learning School Diploma | A secondary diploma or certificate awarded upon completion of an accredited correspondence school course, home study (not home school), internet (computer based virtual) or distant learning program, regardless of whether the diploma was issued by a correspondence school, state, or secondary or post-secondary educational institution. | 7 |
| | | Occupational Program Certificate (Vo/Tech) | An individual who has attended a non-correspondence vocational, technical or proprietary school for at least six months (180 days) i.e. JOB Corps. Individual must have completed 11 years of traditional academic day school, and possesses certificate of completion. Correspondence schools offering vocational certificates are not included. | C |
| III | Non-High School Graduate | N/A | An applicant who is neither a high school graduate nor an alternative credential holder. Tier III applicants must have a 50 QT, 90 GT and NO moral/drug waiver above the recruiting station level. | 1 |
| Note: All Tier II and Tier III applicants for enlistment have completed the 10th grade at a traditional high school. | | | | |

Source: CG, MCRC (2011).

THIS PAGE INTENTIONALLY LEFT BLANK

# APPENDIX C. GEOCODING PROCEDURES

The following steps detail procedures for one iteration of geocoding an enlisted accession cohort in MapInfo. This step-by-step process must be done for each enlisted accession cohort and each active duty locations cohort. Table 17 shows the ZCTA files used as a georeference for each annual cohort.

Table 17. ZCTA Datasets used to Geocode each Annual Cohort.

| Cohort | ZCTA Filename |
|---|---|
| 2000 | tl_2010_us_zcta500.zip |
| 2001 | tl_2010_us_zcta500.zip |
| 2002 | tl_2010_us_zcta500.zip |
| 2003 | tl_2010_us_zcta500.zip |
| 2004 | tl_2010_us_zcta500.zip |
| 2005 | tl_2010_us_zcta500.zip |
| 2006 | tl_2010_us_zcta500.zip |
| 2007 | tl_2010_us_zcta500.zip |
| 2008 | tl_2010_us_zcta500.zip |
| 2009 | tl_2010_us_zcta500.zip |
| 2010 | tl_2010_us_zcta510.zip |
| 2011 | tl_2010_us_zcta510.zip |
| 2012 | tl_2012_us_zcta510.zip |
| 2013 | tl_2013_us_zcta510.zip |
| 2014 | tl_2014_us_zcta510.zip |

1. Within MapInfo, go to HOME>OPEN>TABLE to open the .tab file for the year of interest. Then, open the appropriate ZCTA file as shown in Table 17.

2. Go to SPATIAL>GEOCODE as shown in Figure 11.

3. From the Geocode pop-up window, select the table to be geocoded from the “Geocode Table” drop-down menu. Then, select the appropriate ZIP code variable under the “using Column” field, pick the proper search table (corresponding ZCTA table for year of interest), and choose the ZCTA variable from the “for Objects in Column” drop-down menu. Click on “Interactive” under mode, and then change the symbol to user’s preference, as depicted in Figure 13. Then, click on OK.

4. A second “Geocode” window will pop-up, allowing for interactive geocoding. Upon querying the USPS address database (https://tools.usps.com/go/ZipLookupAction!input.action) using the observation’s city and state, select the most appropriate ZIP code in the

"Geocode" window and click OK, as shown in Figure 14. The GIS user will need to choose a ZIP code for all of the cohort ZIP codes that do not match the ZIP codes provided in the ZCTA dataset. Upon finishing the interactive geocoding, another pop-up window will display the total number of observations geocoded and not geocoded. Figure 9 illustrates the results of geocoding all observations from the 2000 enlisted accession cohort.

5. Save the .tab file, and then repeat steps one through five until all enlisted accession cohorts, active duty locations cohorts, and MCRC locations cohorts get geocoded.

Figure 12. Geocode Icon in MapInfo.

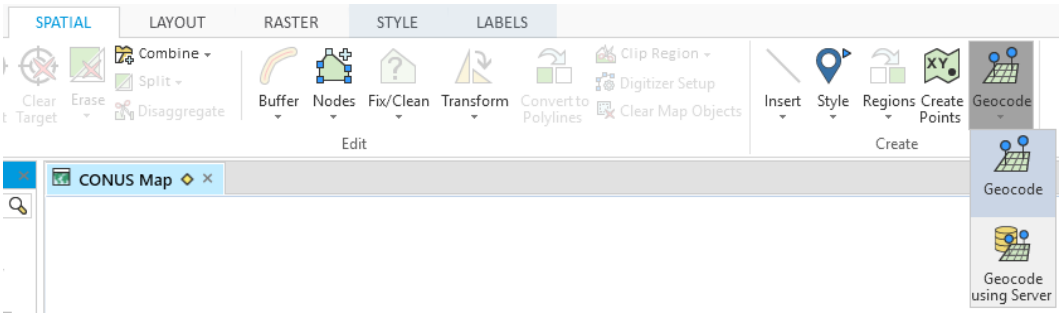



Figure 13. Geocode Pop-up Window.

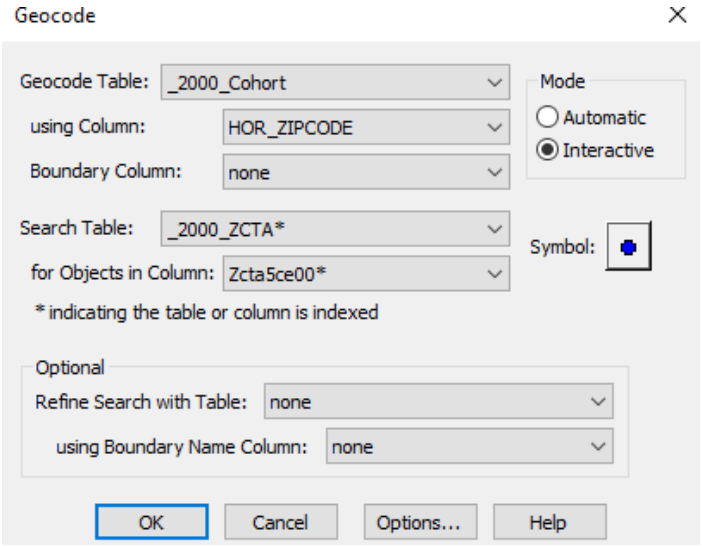
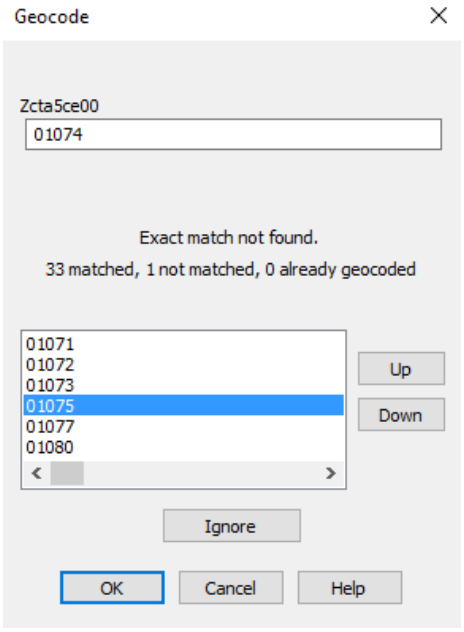


Figure 14. Interactive Geocoding Pop-up Window.



THIS PAGE INTENTIONALLY LEFT BLANK

# APPENDIX D. DEVELOPMENT OF THE GIS MODELS

The following steps detail the procedures used to create the GIS models for an individual enlisted accession cohort for both the active duty locations model and the MCRC locations model. These steps were repeated for each annual enlisted accession cohort for both models.

1. Within MapInfo, go to HOME>OPEN>TABLE to open the active duty locations cohort .tab file of interest. If one is creating the MCRC locations, go to HOME>OPEN>TABLE to open the MCRC locations cohort .tab file of interest.

2. From the HOME tab, make the "Cosmetic Layer" editable and selectable by clicking on the pencil icon, as shown in Figure 15.

3. Go to MAP>SQL SELECT to perform a Structured Query Language (SQL) query that selects all active duty locations.

4. Within the "SQL Select" pop-up window, click on the "Tables" drop-down menu and select the active duty locations table of interest, ensure the "from Tables" field displays the table name, and then type "Obj" in the "where Condition" field, as shown in Figure 16. Leave all other default conditions. An example geographical display of this kind of SQL query is shown in Figure 17.

5. From the map window, go to SPATIAL>BUFFER>BUFFER OBJECTS.

6. When the "Buffer Object" pop-up window appear, set the radius value to 10, ensure miles is selected in the "units" field, smoothness is set at "360" for segments per circle, click on "One buffer for each object" and "Spherical" under the "Buffer Width Distance using," as shown in Figure 18. Then, click on OK.

7. Save the 10-mile radius buffer layer as a table by right-clicking on one of the buffer rings within the map window, and selecting "Save Cosmetic Objects" as displayed in Figure 19. When the "Save Cosmetic Objects" pop-up window appears (Figure 20), choose "<New>" from the drop down menu to create and save a 10-mile radius table.

8. Repeat steps three through seven to create the 25, 50, and 100-mile radius rings, ensuring the radius value is properly set in the value field in the "Buffer Objects" window.

9. Ensure all radius ring tables got closed. Then, open each of the radius ring .tab files for the year and the enlisted accession .tab file for the years of interest.

10. Go to SPATIAL>SQL SELECT to develop a SQL query that identifies enlisted accessions located within each radius ring, as depicted in Figures 21 through 24. The results of each SQL select will open a new browser window. For each SQL radius query, go to HOME>SAVE COPY AS to save a copy of the enlisted accessions falling within each radius ring. Ensure the file format is set to .dbf and the filename indicates the appropriate radius when saving.

11. With the SQL query for the 100-mile radius ring still open, go to SPATIAL>INVERT to select enlisted accession located outside of a 100-mile radius of any active duty location, and then save the results by going to HOME>SAVE COPY AS. Ensure the file format is set to .dbf and the filename indicates the appropriate radius when saving.

12. Open the .dbf files for each radius ring (10, 25, 50, 100 and over 100) using Microsoft Excel.

13. Within each radius ring Excel file, create geospatial dummy variables for each radius ring. For this study, we created five total geospatial dummy variables. The variable names were MILE_RADIUS_10, MILE_RADIUS_25, MILE_RADIUS_50, MILE_RADIUS_100, and MILE_RADIUS_100P. If an enlisted accession observation fell within the 10-mile radius ring, a "1" was assigned to the MILE_RADIUS_10 variable for all observations in the 10-mile radius file, and all other geospatial dummy variable fields were left blank. If an enlisted accession observation fell within the 25-mile radius ring, a "1" was assigned to the MILE_RADIUS_25 variable for all observations in the 25-mile radius file, and all other geospatial dummy variable fields were left blank. If an enlisted accession observation fell within the 50-mile radius ring, a "1" was assigned to the MILE_RADIUS_50 variable for all observations in the 50-mile radius file, and all other geospatial dummy variable fields were left blank. If an enlisted accession observation fell within the 100-mile radius ring, a "1" was assigned to the MILE_RADIUS_100 variable for all observations in the 100-mile radius file, and all other geospatial dummy variable fields were left blank. If an enlisted accession observation fell outside of the 100-mile radius ring, a "1" was assigned to the MILE_RADIUS_100P variable for all observations in the over 100-miles radius file, and all other geospatial dummy variable fields were left blank.

14. Save each of the radius ring file as an independent .xlsx file to facilitate future analyses in STATA.

15. Repeat Steps one through 14 for each annual cohort.

Figure 15. Making the Cosmetic Layer Editable and Selectable.

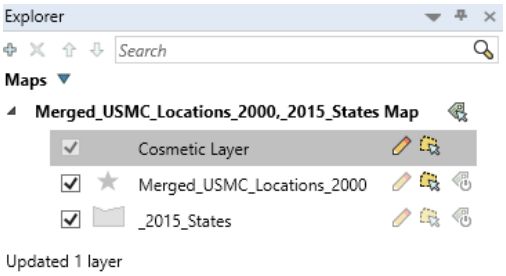



Figure 16. SQL Query to Select Active Duty Locations.

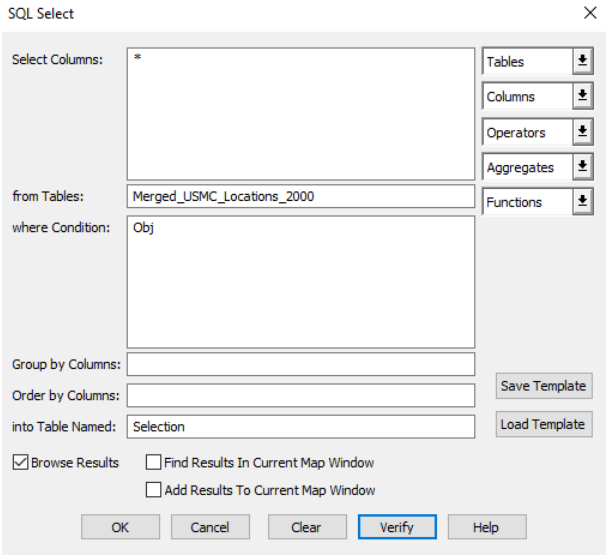



Figure 17. Geographical Depiction of SQL Query Results.

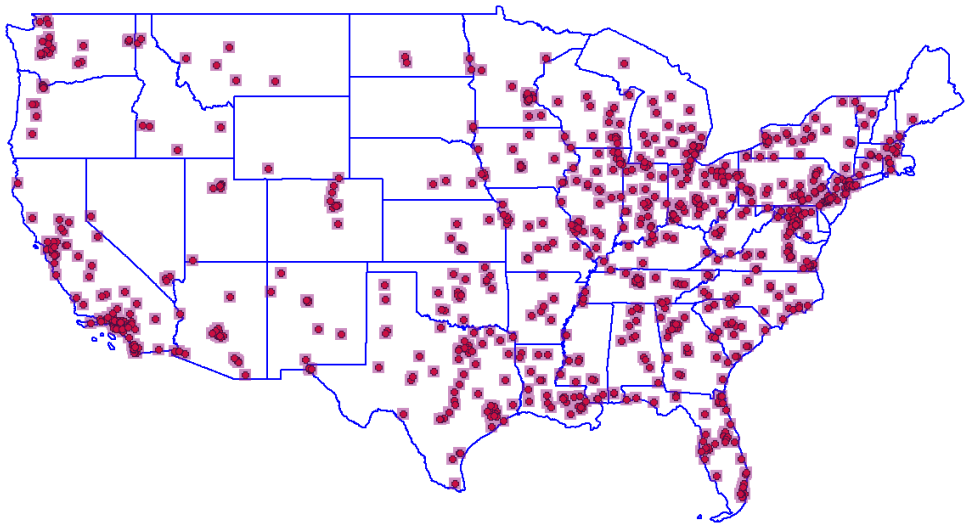


Figure 18. Buffer Objects Pop-up Window.

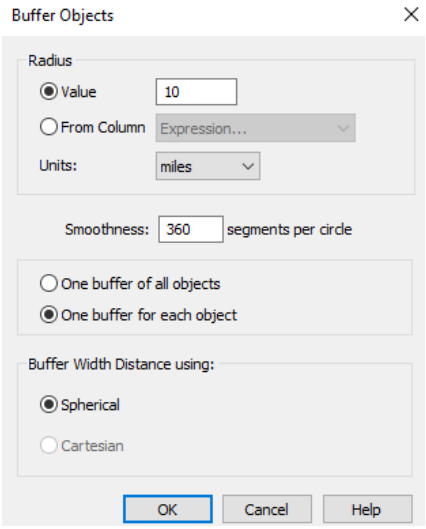



Figure 19. Saving a Radius Buffer Layer.

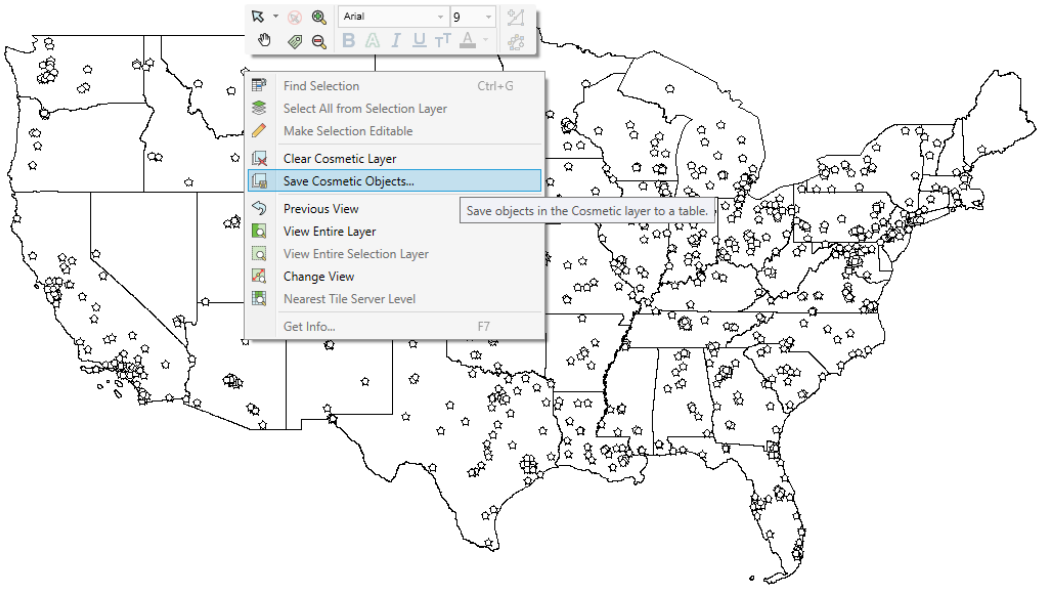
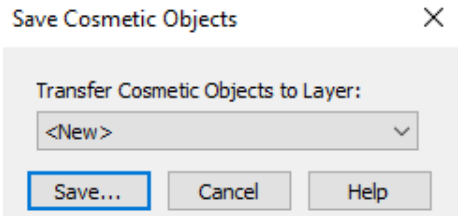



Figure 20. Save Cosmetic Objects Pop-up Window.




`

Figure 21. SQL Query to Select Enlisted Accessions within 10-Mile Radius.

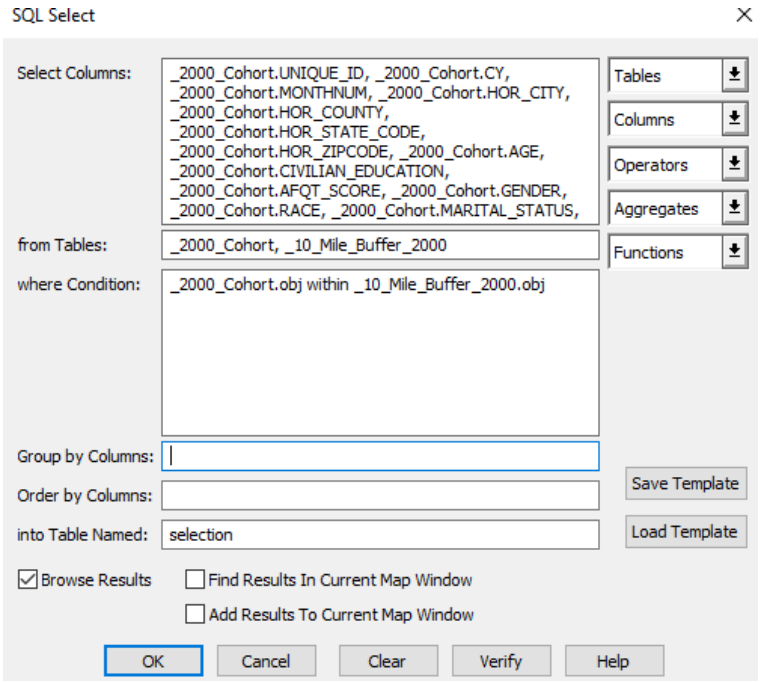
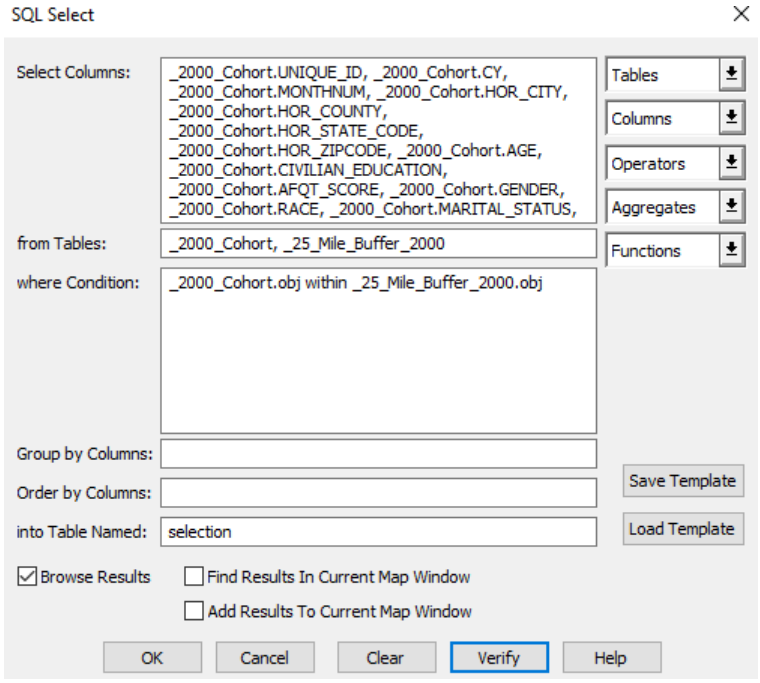



Figure 22. SQL Query to Select Enlisted Accessions within 25-Mile Radius.




`

Figure 23. SQL Query to Select Enlisted Accessions within 50-Mile Radius.

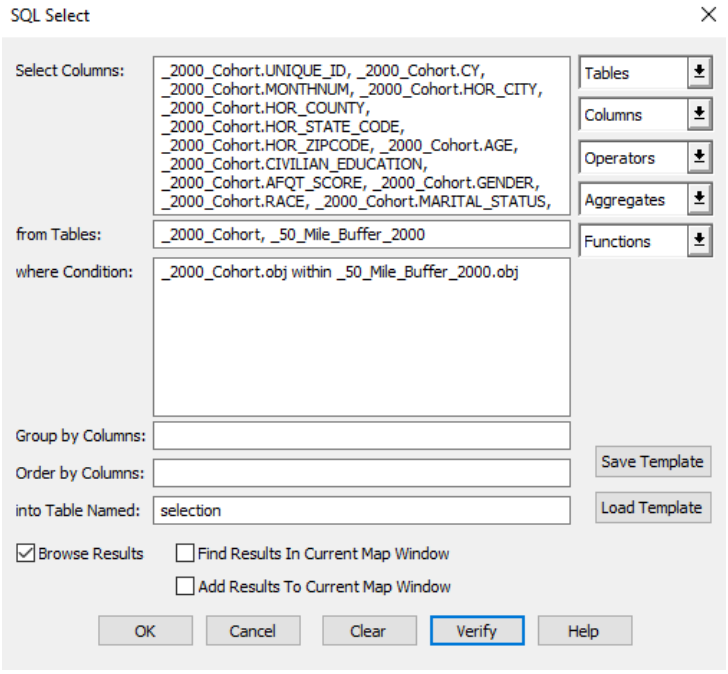
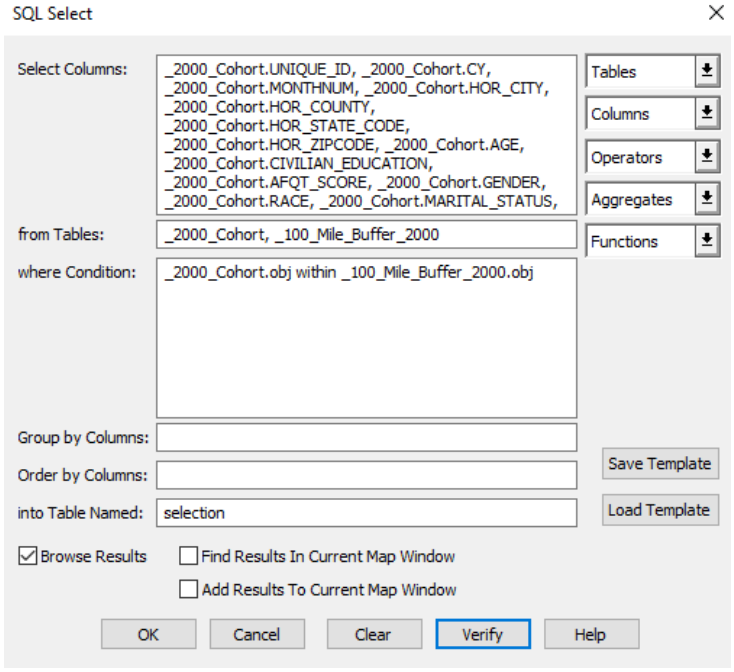



Figure 24. SQL Query to Select Enlisted Accessions within 100-Mile Radius.



# APPENDIX E. AFQT RESULTS BY CALENDAR YEAR

Table 18. Effects on High Quality Accessions by Annual Cohort.

| Variables | All Locations (MLR) | MCRC Locations (MLR) | All Locations (MLR Interact) | MCRC Locations (MLR Interact) |
|---|---|---|---|---|
| acc_cy_2001 | 0.2619* | 0.2591* | 0.2621* | 0.2591* |
| | [0.1459] | [0.1459] | [0.1459] | [0.1459] |
| acc_cy_2002 | 1.0874*** | 1.0846*** | 1.0872*** | 1.0847*** |
| | [0.1460] | [0.1461] | [0.1460] | [0.1461] |
| acc_cy_2003 | 2.2897*** | 2.2880*** | 2.2892*** | 2.2886*** |
| | [0.1464] | [0.1464] | [0.1464] | [0.1464] |
| acc_cy_2004 | 2.1007*** | 2.0967*** | 2.1006*** | 2.0963*** |
| | [0.1478] | [0.1478] | [0.1478] | [0.1479] |
| acc_cy_2005 | 1.6233*** | 1.6196*** | 1.6225*** | 1.6198*** |
| | [0.1473] | [0.1473] | [0.1473] | [0.1473] |
| acc_cy_2006 | 1.8425*** | 1.8370*** | 1.8437*** | 1.8384*** |
| | [0.1480] | [0.1480] | [0.1480] | [0.1480] |
| acc_cy_2007 | 0.5834*** | 0.5779*** | 0.5826*** | 0.5775*** |
| | [0.1464] | [0.1464] | [0.1464] | [0.1464] |
| acc_cy_2008 | 1.1328*** | 1.1286*** | 1.1335*** | 1.1305*** |
| | [0.1420] | [0.1420] | [0.1420] | [0.1420] |
| acc_cy_2009 | 2.8023*** | 2.7982*** | 2.8028*** | 2.7988*** |
| | [0.1480] | [0.1480] | [0.1480] | [0.1480] |
| acc_cy_2010 | 4.2581*** | 4.2520*** | 4.2585*** | 4.2537*** |
| | [0.1531] | [0.1531] | [0.1531] | [0.1531] |
| acc_cy_2011 | 4.3597*** | 4.3518*** | 4.3600*** | 4.3521*** |
| | [0.1498] | [0.1498] | [0.1498] | [0.1498] |
| acc_cy_2012 | 4.5508*** | 4.5477*** | 4.5522*** | 4.5486*** |
| | [0.1467] | [0.1467] | [0.1467] | [0.1467] |
| acc_cy_2013 | 3.6810*** | 3.6752*** | 3.6807*** | 3.6759*** |
| | [0.1435] | [0.1435] | [0.1435] | [0.1435] |
| acc_cy_2014 | 3.7192*** | 3.7143*** | 3.7192*** | 3.7147*** |
| | [0.1491] | [0.1491] | [0.1491] | [0.1491] |
| Constant | 45.9422*** | 45.9284*** | 45.7376*** | 45.7571*** |
| | [0.4281] | [0.4273] | [0.6676] | [0.6626] |
| $R^2$ | 0.035 | 0.035 | 0.035 | 0.035 |
| Adjusted $R^2$ | 0.0352 | 0.0351 | 0.0352 | 0.0352 |

Observations (n = 448,018)
Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

THIS PAGE INTENTIONALLY LEFT BLANK

# LIST OF REFERENCES


Asch, B. J., Hosek, J. R., & Warner, J. T. (2007). New economics of manpower in the post-cold war era. In K. Hartley & T. Sandler (Vol. 2), *Handbook of Defense Economics* (pp. 1075–1138). Amsterdam: Elsevier.

Bachman, J. G., Segal, D. R., Freedman-Doan, P., & O'Malley, P. M. (2000). Who chooses military service? Correlates of propensity and enlistment in the U.S. Armed Forces. *Military Psychology*, *12*(1), 1–30. doi:http://dx.doi.org/10.1207/S15327876MP1201_1

Choike, D. J., & Zeliff, M. W. (2010). *Marine Corps Recruiting Command* [PowerPoint presentation]. Retrieved from http://www.cops.usdoj.gov/pdf/conference/rand/ChoikeZeliffPresentation.pdf

Chung, Y. C. (1995, September). *Meta analysis on high quality recruiting enlistments* (Master's thesis, Naval Postgraduate School). Retrieved from Calhoun http://hdl.handle.net/10945/35122

Commandant of the Marine Corps (CMC). (2009a). *Total force structure process* (MCO 5311.1D). Retrieved from http://www.marines.mil/News/Publications/ELECTRONIC-LIBRARY/

Commandant of the Marine Corps (CMC). (2009b). *Total force recruiting* (MCO 1130.56D). Retrieved from http://www.marines.mil/News/Publications/ELECTRONIC-LIBRARY/

Commanding General (CG), Marine Corps Recruiting Command (MCRC). (2011, November 9). *Marine Corps Recruiting Command enlistment processing manual* (MCRCO 1100.1). Retrieved from http://www.hqmc.marines.mil/Portals/61/Docs/FOIA/MCRCO1100.1EPM.pdf

Congressional Budget Office (CBO). (2006, October). *Recruiting, retention, and future levels of military personnel* (CBO Publication No. 2777). Washington, DC: U.S. Government Printing Office. Retrieved from https://www.cbo.gov/publication/18187

Dertouzos, J. (1985). *Recruiter incentives and enlistment supply* (R-3065-MIL). Santa Monica, CA: RAND. Retrieved from: http://www.rand.org/pubs/research_briefs/RB2004-1.html

Doh, J. P., & Hahn, E. D. (2008). Using spatial methods in strategy research. *Organizational Research Methods, 11*(4), 659–681. Retrieved from http://doi.org/10.1177/1094428107300340

Ehrenberg, R. G., & Smith, R. S. (2012). *Modern labor economics theory and public policy* (11th ed.). Boston, MA: Prentice Hall.

End Strength. (2015, March 3). Retrieved from https://marinecorpsconceptsandprograms.com/programs/manpower/end-strength

Faulds, D. J., & Gohmann, S. F. (2001). Adapting geodemographic information to Army recruiting: The case of identifying and enlisting Private Ryan. *The Journal of Services Marketing, 15*(3), 186–210. Retrieved from http://search.proquest.com.libproxy.nps.edu/docview/212651339/675893A1B543DDPQ/1?accountid=12702

Griesmer, D. M. (2006). Understanding Marine Corps recruiting. *Marine Corps Gazette, 90*(4), 47–48. Retrieved from http://libproxy.nps.edu/login?url=http://search.proquest.com/docview/221445736?accountid=12702

Headquarters, United States Marine Corps. (1997). *Warfighting* (MCDP-1). Washington, DC: Author. Retrieved from http://www.marines.mil/Portals/59/Publications/MCDP%201%20Warfighting.pdf

Hosek, J. R., & Peterson, C. E. (1985). *Enlistment decisions of young men* (R-3238-MIL). Santa Monica, CA: RAND. Retrieved from http://www.rand.org/pubs/reports/R3238.html

Khalid, A. (2015, December 10). Millennials want to send troops to fight ISIS, but don't want to serve. *National Public Radio*. Retrieved from http://www.npr.org/2015/12/10/459111960/millennials-want-to-send-troops-to-fight-isis-but-not-serve

Kilburn, R., & Klerman, J. A. (1999). *Enlistment decisions in the 1990s: Evidence from individual-level data* (MR-944-OSD/A). Santa Monica, CA: RAND. Retrieved from http://www.rand.org/pubs/monograph_reports/MR944.html

Mann, D. R. (2011). *Choosing to serve: Understanding the military participation decision* (Doctoral dissertation, University of Pennsylvania). Retrieved from http://repository.upenn.edu/cgi/viewcontent.cgi?article=1427&context=edissertations

Manpower Plans, Programs and Budget Branch (MPP-20). (2016). Retrieved from: https://www.manpower.usmc.mil/webcenter/portal/MPP20

Marine Corps Total Force System (MCTFS). (2016). Retrieved from https://tfsms.mccdc.usmc.mil/

Marine Corps University. (2016). Marine Corps end strengths. Retrieved from http://www.mcu.usmc.mil/historydivision/pages/frequently_requested/EndStrength.aspx

Neller, R. (2016, January 19). *FRAGO 01/2016: Advance to contact* (37th Commandant's Planning Guidance). Retrieved from http://www.marines.mil/News/Publications/ELECTRONIC-LIBRARY/

Office of the Under Secretary of Defense (Comptroller). (2015, February). *Operation and maintenance overview fiscal year 2016 budget estimates*. Retrieved from http://comptroller.defense.gov/Budget-Materials/

Office of the Under Secretary of Defense (Comptroller). (2009, June). *Operation and maintenance overview fiscal year 2010 budget estimates*. Retrieved from http://comptroller.defense.gov/Budget-Materials/

Perri, T. J. (2013). The evolution of military conscription in the United States. *The Independent Review, 17*(3), 429–439. Retrieved from http://libproxy.nps.edu/login?url=http://search.proquest.com/docview/1267804171?accountid=12702

Ramirez, M. A., & Park, D. H. (2003, March). *The Marine Corps enlisted assignment process: The customer's perspective* (Master's thesis, Naval Postgraduate School). Retrieved from Calhoun http://hdl.handle.net/10945/1071

Ray, M. (2015). Selective service acts. In *Encyclopædia Britannica online. Retrieved from http://www.britannica.com/topic/Selective-Service-Acts*

Reich, J. D., & Kozlusky, G. R. (1994). The new recruiting command and the story of Marine Corps recruiting. *Marine Corps Gazette, 78*(8), 62–69. Retrieved from http://libproxy.nps.edu/login?url=http://search.proquest.com/docview/221422470?accountid=12702

Rosen, S. (1986). The theory of equalizing differences. In O. Ashenfelter & R. Layard, (Eds.), *Handbook of Labor Economics* (pp. 641–692). North-Holland, Amsterdam.

Shinkman, P. (2013). Obama: Global war on terror is over. *U.S. News & World Report*. Retrieved from http://www.usnews.com/news/articles/2013/05/23/obama-global-war-on-terror-is-over

Sleight, P., & Leventhal, B. (1989). Applications of geodemographics to research and marketing. *Market Research Society. Journal of the Market Research Society, 31*(1), 75. Retrieved from https://nps.illiad.oclc.org/illiad/illiad.dll?Action=10&Form=75&Value=159177

`

U.S. Census Bureau. (2015). ZIP code tabulation areas (ZCTAs). Retrieved from https://www.census.gov/geo/reference/zctas.html

U.S. Marine Corps. (2016). History & heritage: Timeline. Retrieved from http://www.marines.com/history-heritage/timeline

Warner, J., & Asch, B. (1995). The economics of military manpower. In K. Hartley & T. Sandler (Vol. 1), *Handbook of Defense Economics* (pp. 347–398). Amsterdam: Elsevier.

# INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California